Ann Arbor

Proceedings of the Boston Society of Natural History.
Vol. 41, No. 6.
p. 211–402.

# BICKNELL'S THRUSH, ITS TAXONOMY, DISTRIBUTION, AND LIFE HISTORY.

By George J. Wallace.

BOSTON:
PRINTED FOR THE SOCIETY.
January, 1939.

Digitized by the Internet Archive
in 2026

https://archive.org/details/IA41549007_0005

**Proceedings of the Boston Society of Natural History.**
Vol. 41, No. 6.
p. 211–402.

---

# BICKNELL'S THRUSH, ITS TAXONOMY, DISTRIBUTION, AND LIFE HISTORY.

By George J. Wallace.

(A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the University of Michigan, June, 1936.)

---

BOSTON:
PRINTED FOR THE SOCIETY.
January, 1939.

R. UNIV.
BIBLIOTHEEK
LEIDEN

# BICKNELL'S THRUSH, ITS TAXONOMY, DISTRIBUTION, AND LIFE HISTORY[1]

BY GEORGE J. WALLACE

CONTENTS

PAGE

Introduction ..... 213
Material and Methods ..... 214
Acknowledgments ..... 215

PART I

TAXONOMY AND NOMENCLATURE OF GRAY-CHEEKED THRUSHES

The Genus *Hylocichla* ..... 217
The *Hylocichla minima* group ..... 218
Apparent Natural Divisions of *Hylocichla minima* group ..... 219
  Northern Gray-cheeked Thrush ..... 219
  Newfoundland Gray-cheeked Thrush ..... 224
  Bicknell's Thrush ..... 229
Summary of Color Phases Among Gray-cheeked Thrushes ..... 235
Taxonomic Considerations ..... 236
Nomenclature ..... 238

PART II

DISTRIBUTION AND MIGRATION OF BICKNELL'S THRUSH

Introduction ..... 242
Breeding Range ..... 242
Migration Records ..... 259
Winter Distribution ..... 272

PART III

THE HOME LIFE OF BICKNELL'S THRUSH

Introduction ..... 280
The Mt. Mansfield Region ..... 280
  Physiographical Features ..... 280
  Climatic Considerations ..... 281
  Life Zones ..... 283
Arrival on Breeding Grounds ..... 291
Food Habits ..... 294
Song and Call Notes ..... 300
Mating and Courtship ..... 317

[1]Contribution from the Department of Zoology, University of Michigan.

PAGE

Nesting Habits . . . . . 318
Nesting Records . . . . . 319
Nest Building . . . . . 323
Eggs and Egg Laying . . . . . 332
Incubation . . . . . 333
Hatching . . . . . 340
Care and Development of Young . . . . . 342
The Departure from the Nest . . . . . 355
Breeding Rate and Mortality Factors . . . . . 358
A Study of Caged Specimens . . . . . 364
Postjuvenal and Postnuptial Molts . . . . . 367
Departure from the Mountain . . . . . 369

Summary and Conclusions . . . . . 369
Literature Cited . . . . . 378
Appendix . . . . . 387
Measurements of Northern Gray-cheeked Thrushes . . . . . 387
Measurements of Newfoundland Gray-cheeked Thrushes . . . . . 389
Locality Records for Bicknell's Thrush . . . . . 392

## Introduction

One of the most deeply impressed memories of my early experiences with birds recalls a rocky, mist-blanketed mountain whose avifauna differed singularly from that of the home woods less than ten miles away. To me the most remarkable of these height-dwelling birds was a shy, brownish-backed thrush that in the evening poured out his wild and fascinating song till the rocky, fir-clad summit echoed with the ringing melody. This mysterious singer, I soon learned, was called Bicknell's thrush; but little else could I find about it from any source. Consequently, in a youthful and aspiring mood I resolved that some time in the future I would contribute to ornithological knowledge by revealing the little known home life of this rare and seclusive bird. Perhaps influenced to some extent by this early resolution, partly no doubt by purely fortuitous development, a study of this form was finally undertaken.

A purely life-history study was begun in good faith; but the obvious discrepancies in locality records based on dubious skins early pointed to the necessity of examining the specimens involved. Study of the skins, as well as correspondence with ornithologists who had had previous occasion to deal with this particular group, gradually disclosed the systematic confusion existing among the gray-cheeked thrushes. A superficial study of the situation, instead of clarifying this confusion, only served to expose deeper complications, thus virtually compelling a more careful investigation of the whole matter. Moreover, it soon became apparent that the type specimen of the species, which had already had a long and complicated nomenclatural history, was still misidentified; thus a complete taxonomic revision of the species-group was required.

Obviously such a subject affords a singularly fertile field for investigation — a species whose systematic status is in confusion, whose nomenclature demands revision, whose distribution is only partially known, and whose nesting habits form one of the most obscure chapters in the annals of American ornithology. It has been the aim and purpose of this investigation, therefore, to bring together as much information as possible pertaining to this one species. Although special emphasis has been placed on life-history studies of the smaller subspecies, known as Bicknell's thrush, nevertheless no little effort has been spent in attempting to

solve the systematic problems involved. Yet, unfortunately, although the writer feels that he has exposed the fundamental situation in regard to the different forms and phases and their distribution, the exact systematic relationships of these various types cannot be unquestionably determined without additional evidence, some of which will be very difficult to obtain.

In regard to organization of material the problem automatically seems to separate into the three natural divisions followed in this paper. Part I deals with taxonomy and nomenclature. Part II, concerned with year-around distribution, is essentially a compilation of all available locality records, which the writer has spared no pains to collect. Part III presents the results of two summers' life-history studies made on Mt. Mansfield, Vermont.

## Materials and Methods

In the course of the taxonomic work the writer has visited and studied the pertinent collections in the Museum of Comparative Zoology, the United States National Museum, the United States Biological Survey, the American Museum of Natural History, the Brooklyn Museum, the Boston Society of Natural History, the New York State Museum in Albany, the Royal Ontario Museum and the J. H. Fleming collection in Toronto, and the Carnegie Museum in Pittsburgh. In addition specimens have been borrowed from Dr. L. B. Bishop's collection in New Haven, the Victoria Memorial Museum in Ottawa, the Academy of Natural Sciences in Philadelphia, the Alabama Museum of Natural History, the Field Museum of Natural History, the Chicago Academy of Sciences, and the C. W. G. Eifrig collection in River Forest, Illinois. Further valuable specimen measurements have been supplied from the Princeton Museum through the courtesy of Mr. C. H. Rogers, and from the British Museum through Mr. N. B. Kinnear.

Altogether, in this study, 428 specimens have been examined and measured, 169 of which are the smaller ("rare") form. All measurements have been taken in millimeters. Wing lengths were obtained by holding a ruler beneath the wing and measuring the distance from the bend of the wing (the carpal joint) to the tip of the longest (8th) primary. No attempt was made to secure an additional millimeter by pressing the wing out flat. For the most part these measurements check closely with those taken by other ornithologists. Retrical lengths were taken by placing one point of the dividers between the two middle retrices as far

forward as it would go without splitting the integument and measuring the distance to the tip of the longest tail feather. This measurement is apt to differ when taken by different examiners. Tarsal lengths are from the tibio-tarsal joint to the junction of the tarsus with the toes. The bill is measured from the tip to the base where the feathers begin.

Capitalized colors are from Ridgway's *Color Standards and Color Nomenclature.*

## Acknowledgments

Successful completion of nearly every investigation in ornithology is partially dependent upon information obtainable from other ornithologists. The need for correspondence regarding specimens, museum records, and local observations is often an imperative one, and this research is no exception. The gathering together of locality records, many of which now appear for the first time, has been made possible only by continuous correspondence with ornithologists in many parts of the United States, southeastern Canada, and even abroad. One of the gratifying features of the work has been the kind cooperation of curators of collections, teachers, and other ornithologists, who, although always busy with other duties, have nevertheless freely taken time to answer letters of inquiry, to examine specimens and to offer information, opinions and suggestions.

Acknowledgments are due first to Dr. Frank N. Blanchard of the Zoology Department of the University of Michigan under whose supervision the research has been conducted. Dr. Josselyn Van Tyne, Curator of the Bird Division of the University Museum of Zoology, has also been unfailing in his willingness to offer information and criticism, and to examine specimens. Dr. Frieda C. Blanchard has been exceedingly helpful in reading and criticizing the manuscript.

Particularly grateful acknowledgments should be made to several among the many who directly or indirectly contributed to this study. Dr. H. C. Oberholser of the Biological Survey has shown an especially kindly interest throughout the investigation, answering many letters of inquiry, loaning specimens, and going over dubious skins with the writer. Mr. James L. Peters of the Museum of Comparative Zoology extended many courtesies during the writer's visit to Cambridge, and in addition has repeatedly loaned specimens, and offered suggestions and criticisms. Mr. A. C. Bent has turned over his unpublished field notes of observations on Seal Island birds, generously granting unrestricted use of them.

Dr. L. B. Bishop has kindly loaned me his entire personal collection of Bicknell's thrush, one of the best in existence.

Other ornithologists who have shown a helpful interest in this work by loaning specimens or by correspondence or both are: Mr. J. H. Fleming of Toronto, Mr. P. A. Taverner of the Victoria Memorial Museum of Ottawa, Dr. Harrison F. Lewis of Ottawa, Professor V. C. Wynne-Edwards of McGill University, Dr. A. O. Gross of Bowdoin, Mr. George Ross of Rutland, Vermont, Dr. Ernest Mayr and Mr. John T. Zimmer of the American Museum, Dr. A. G. Whitney of the New York State Museum, Mr. Chandler Robbins of the Boston Society of Natural History, Mr. Louis B. Gillet of New Haven, Mr. Stanley Ball of Yale, Mr. C. H. Rogers of Princeton, Dr. Witmer Stone of the Academy of Natural Sciences of Philadelphia, Mr. A. H. Howell, W. L. McAtee, and Thomas Burleigh of the Biological Survey, Dr. Herbert Friedman of the United States National Museum, Mr. W. E. C. Todd of Carnegie Museum, Mr. A. M. Bailey of the Chicago Academy of Sciences, Mr. Rudolph Bennitt of the University of Missouri, Walter B. Jones of the Alabama Museum of Natural History, and N. B. Kinnear of the British Museum.

Acknowledgments would be ungratefully incomplete without a genuinely appreciative mention of a helpful and cooperative wife, who, in addition to typing the entire manuscript twice, has typed innumerable letters, reference cards, and pertinent articles. By her recording of measurements during a rapid tour of some eastern museums much valuable time was saved. Moreover, she has been a capable field assistant, hunting for nests, sitting in blinds, and making useful observations.

The writer also harbors a feeling of indebtedness and gratitude toward the Burlington Section of the Green Mountain Club for the use of Mabel Taylor Butler Lodge, which chanced to be ideally located for field studies; and to the proprietors of Mt. Mansfield Hotel for making supplies and other facilities more readily available.

Final and especially grateful acknowledgment should be made to Miss Parsons of Stonover, Lenox, Massachusetts, whose generous and timely financial contribution has made the publication of this research possible.

# PART I

## TAXONOMY AND NOMENCLATURE OF GRAY-CHEEKED THRUSHES

### The Genus *Hylocichla*

The genus *Hylocichla* belongs to the family *Turdidae* and comprises brown or olive-backed, spotted-breasted, wood-haunting thrushes, divisible into five well-defined but, for the most part, very similar species. These in turn break up into more than a dozen subspecies. They breed mainly in northern United States and northward, migrating to the southern states, the West Indies and South America for winter. Their renown as vesper singers of exceptional quality and superiority is too well known to need further comment here.

The wood thrush (*Hylocichla mustelina*) is the largest and southernmost member of the genus, inhabiting practically all of this country east of the Rockies, and gradually extending its northern frontier farther and farther into sub-Canadian regions. Unlike the other members of the genus it has emerged from the seclusiveness of the deep forests so beloved by other hylocichlids, and dwells in open woodlands and city parks in well-populated districts.

The veeries (*Hylocichla fuscescens* subsp.) inhabit the deep swamps and damp lowlands of northern United States and lower Canada. In quality and character of song they closely resemble Bicknell's thrushes, but differing structural features suggest that the similarity may be chance parallelism rather than direct relationship.

The hermit thrushes (*Hylocichla guttata* subsp.), consisting of nearly a dozen subspecies, inhabit the deep forests of the northern tier of states and Canada, some of the western races extending their range into Alaska. In the estimation of many American bird-lovers the hermit thrush deserves the title of the world's most accomplished melodist, the nightingale, skylark, and other celebrated European songsters notwithstanding.

The olive-backed thrush (*Hylocichla ustulata swainsoni*), with its western relative, the russet-backed thrush, is even more boreal than the preceding members of this genus, breeding from northern United States north to the tree limit. Because of its close resemblance to the gray-cheeked thrushes these forms were once considered subspecifically allied,

and J. A. Allen refused to recognize the olive-back even as a racially distinct form. Later, however, it was emphatically demonstrated that, since the two forms were found breeding side by side throughout practically the whole of their range, without the slightest degree of intergradation, the olive-back must be a specifically valid form. Their resemblance to the gray-cheeks appears to be somewhat superficial, since even where the two exist together they are quite different in songs and nesting habits.

The gray-cheeked thrushes (*Hylocichla minima* subsp.), divided at the present time into *minima*, the Bicknell's thrush, and *aliciae*, the gray-cheeked (or Alice's) thrush, inhabit the bleakest and most isolated areas of any of the members of this essentially northern genus. The larger form, *aliciae*, is mainly confined to the extreme northern parts of the continent near, and even beyond, the tree limit. The smaller form, or Bicknell's thrush, breeds farther south, either at high altitudes in the mountains of northeastern United States or along certain Canadian maritime coasts and on oceanic islands in the southeastern portions of that country. The larger, northern race is widely distributed over practically all of northern Canada and Alaska, and is common over nearly all parts of its wide range; but the smaller, southern race, with which this paper chiefly deals, is peculiarly local and restricted in distribution, and is considered rare over all parts of its limited range. Moreover its shyness and seclusiveness, its habit of breeding in only the most inaccessible places, and its almost unbroken silence during most of the year have kept the taxonomic, distributional, and life-history facts concerning it in mystery so long that it has been correctly regarded as one of the least known of American passerine birds.

The gray-cheeked thrushes have long bothered those systematists who have had occasion to identify mixed specimens, and not a few have expressed the opinion that the situation demands more careful study. This confusion has been due not alone to difficulties in identifying specimens of races separable only by slight and often overlapping differences in measurements, but also to a peculiar color inconstancy repeatedly noted in the smaller form. Ridgway's original description of the smaller race, as well as Brewster's and Bicknell's critical comments on the first breeding specimens, alluded to certain indefinite plumage variations, so that color had to be rejected as a distinguishing character and size used as the sole criterion for separating the two forms. Though the occurrence of this variously interpreted bi-phase color condition in Bicknell's thrush has

now become known to a number of recent ornithologists, no one appears to have noticed that this dichromatic condition applies to the larger form as well. As a consequence of this misunderstanding, many specimens have been erroneously identified. Moreover, Ridgway's measurements, which have been universally used, but which were based on an inadequate number of specimens, no longer seem to be satisfactory, and have resulted in still more errors in identifications.

A careful study of many specimens from all parts of the species range, however, seems to indicate the natural divisions into which both size forms and color types fall. It is hoped that the following detailed account of these divisions will clarify many of the dubious features that have remained so long unsettled.

## The Apparent Natural Divisions of *H. minima*

It appears that the gray-cheeked group of thrushes, now divided into a northern and a southern form on the basis of size, may be again separated on the basis of color, each size race forming two color phases which show a certain amount of geographic segregation. Thus there are two forms, or phases, of *aliciae* on their far northern breeding grounds, a continental and a Newfoundland form; and two of *bicknelli* in New England. The following pages are devoted to a consideration of these four types.

## The Northern Gray-cheeked Thrush

**Breeding Range.** This gray-cheek, to which the term "northern" may be applied to distinguish it from the Newfoundland type, breeds in the extreme northern parts of the continent from the coast of Labrador (north of the Straits of Belle Isle) northwestward throughout northern Canada and Alaska to eastern Siberia. Specific localities are Labrador (Battle Harbor, Davis Inlet, Eskimaux Point, Makkovik, Mannock's Island; Groswater Bay, Assizes Harbor, Nain, and Aillik); Northern Quebec (Fort Chimo); Manitoba (York Factory, Fort Churchill); Keewatin (Repulse Bay); Mackenzie (Fort Anderson, Fort Providence, Fort Good Hope, Wilmot-Horton River, Fort Rae, Loon Islands, Simpson Islands, Lake Hardisty, McTavish Bay, Sans Saulte Rapid, Great Slave Lake, and Artillery Lake); Yukon (Coal Creek); Alaska (Nome, Port Clarence, McKinley Park, Circle, Kowak River, St. Paul, Kodiak

Island, Kenai, Norton Sound, Swan Lake, Kakhtul River, Alekmagik Lake, Nushagak, Yukon River, Birch Creek, St. Micheal, Pribilofs); and Siberia (Cape Tschukotsk, Chuckche, Kolyma River, Neshon Kolymsk).

A study of the list of specimens examined from these regions (page 387) may give a better conception of the distribution of collected specimens; but this list is incomplete, as only a part of the skins available in various museums have been examined. Nor has any attempt been made to exhaust the published records. One striking feature of the distribution of this form is its apparant preference for coast lines, islands, rivers, and lakes. The presence of sheltering thickets of alder and willow bordering the streams and water courses in these otherwise often treeless regions presumably accounts for such a pattern of distribution. Though they inhabit forested areas near the tree limit, they also extend their breeding frontier far beyond the coniferous woods, probably reaching their maximum abundance along the thicket-fringed tributaries of the Mackenzie and Yukon Rivers.

**Plumage.** The adult summer or breeding plumage is typically Grayish Olive above, sometimes varying to Brownish Olive. The prevailing grayness of the dorsal plumage is more pronounced in this form than in any of the other types, and more so than in this form at other seasons of the year. Remiges and retrices, especially of birds in their second summer (first breeding summer) may be washed with brownish. The cheek region is streaked with shades of grayish white and darker gray, rarely with the buffy tinge which becomes so pronounced in the olive-backed thrush. Under parts are white, shading into pale Grayish Olive on the sides and flanks; chest Buffy White to pale Cream-Buff, marked with triangular spots of Sooty Black or Grayish Dusky (Ridgway, 1907).

By a complete postnuptial molt in August these gray-cheeks become a fresh Brownish Olive above, with the Creamy Buff of the chest and lower throat more pronounced. This plumage they retain till the following summer, although by continued wear the bright olive freshness of the newly molted plumage gradually varies in the direction of Grayish Olive so that spring specimens can often be distinguished from autumn skins by the grayer olive of the dorsal feathers. Transition from fall and winter plumage to the breeding plumage is supposed to be entirely by wear (mechanical disintegration plus chemical discoloration), but the transition is greatly accelerated when the breeding grounds are reached, possibly due to long exposure to the practically continuous arctic day. Spring migrants taken in northern United States and Canada, and even

late May and early June specimens from Alaska, may still be in the olive-colored migration plumage, but later June and July specimens almost (but not quite) invariably have changed to the Grayish Olive garb of summer.

The exception is that occasional summer specimens that still retain their Brownish Olive plumage may be taken in these far northern regions, as if breeding in migration dress. Whether this is due to occasional spring molts, merely range of variation, presence of non-breeding birds, or the bi-phase color condition creeping into the continental gray-cheek stock is difficult to determine. Otherwise, all the way from Labrador to Siberia, there is very little variation among individuals of the form and they seem a very stable race.

**Measurements.** Wing measurements are the most reliable, and often the only dependable criterion for separating the larger and smaller forms of this species. Only adult summer specimens with relatively unfrayed wings were used for taking measurements. Partial wear of the primaries, however, may be considered typical of breeding birds, since the remiges are acquired during the previous summer's molt, and only in cases where the wing seemed to have lost part of its length were skins rejected. Undoubtedly fall specimens would form a better criterion of wing lengths, but all intermediate-sized specimens would have to be rejected because they might be examples of the smaller form. Moreover, so many fall specimens are wrongly sexed that male and female averages would be inaccurate. The object here is to derive an accurate standard of measurements for making critical subspecific determinations; this can be done only by using adults from the breeding grounds.

The measurements thus obtained show a variation in males from 98 to 108 mm. and in females from 95 to 104 mm., with averages of 103.2 and 98.8 respectively. The figures are summarized in Table I. Measurements and localities of all specimens examined will be found on pages 387 and 388.

These measurements differ from Ridgway's in one important respect: the minimum wing length is lowered from 97 to 95 mm. for females and from 99 to 98 mm. for males. Possibly part of this difference may be because Ridgway's measurements were taken with dividers (by Mr. J. H. Riley), but it seems more logical to lay it to his smaller series of breeding specimens (five females and eleven males, all from Alaska).

TABLE I

*Summary of Wing Lengths of Northern Gray-Cheeked Thrush*

| SEX | MINIMUM | MAXIMUM | AVERAGE | NUMBER OF SPECIMENS |
|---|---|---|---|---|
| ♂ | 98 | 108 | 103.2 | 27 |
| ♀ | 95 | 104 | 98.8 | 18 |
| Total Range | 95 | 108 | 101.5 | 45 |

As will be shown in more detail in considering locality records, many specimens of this larger form have been incorrectly identified because they fall slightly below previously accepted standards. Lowering the minimum for the larger, and the maximum for the smaller, form, which is justified by examination of breeding specimens, changes the identity of many dubious specimens and emphatically settles many controversies regarding intermediate birds from the interior, heretofore misidentified as Bicknell's thrush.

Tail length as a distinguishing character is much less diagnostic than wing length. Not only is it more variable, but tail lengths in the two size forms overlap to such an extent that this measurement is useful only in a general way in identifying individual specimens. The figures obtained are 63 to 74 mm. (average 68.4 mm.) for males and 63 to 72 mm. (average 65.8 mm.) for females. (See Table II.)

TABLE II

*Summary of Tail Lengths of Northern Gray-Cheeked Thrush*

| SEX | MINIMUM | MAXIMUM | AVERAGE | NUMBER OF SPECIMENS |
|---|---|---|---|---|
| ♂ | 63 | 74 | 68.4 | 28 |
| ♀ | 63 | 72 | 65.8 | 18 |
| Total Range | 63 | 74 | 67.3 | 46 |

The tarsal lengths in males are 28 to 33 mm., average 30.9 mm., and in females 28 to 31, average 29.4 (Table III). Further mention of this

feature will be found under the discussion of this measurement for Bicknell's thrush (page 231).

TABLE III

*Summary of Tarsal Lengths of Northern Gray-Cheeked Thrush*

| SEX | MINIMUM | MAXIMUM | AVERAGE | NUMBER OF SPECIMENS |
|---|---|---|---|---|
| ♂ | 28 | 33 | 30.9 | 27 |
| ♀ | 28 | 31 | 29.4 | 20 |
| Total Range | 28 | 33 | 30.2 | 47 |

The bill length, though usually recorded in taking measurements, is apparently of no diagnostic value, and therefore may be dismissed without deriving averages. It varies from 11 to 15 mm., but the two extremes are rare, the normal range falling from 12 to 14 mm. inclusive.

**Breeding Habits.** These thrushes arrive on their far northern breeding grounds in late May and early June. The general timidity and habit of concealment in dense thickets known to be characteristic of Bicknell's thrush apparently also applies to its larger northern relative (Coues, 1861). Many observers have noted their occurrence among the willow and alder thickets bordering the larger rivers and their tributaries, where their "whistled call or clear ringing song may often be heard" (Hersey, 1917). In June they build a mossy nest which later contains four to six pale bluish green eggs, faintly speckled with brownish blotches. The young are reared in July. The postnuptial molt is begun in early August, the Thayer collection containing a completely molted specimen from Nome, Alaska, dated August 8, although this is earlier than the average. Before the end of August they may be moving out of their arctic quarters, pending the long migration.

**Migration.** Gray-cheeked thrushes move southward in September over the whole of Canada east of the Canadian Rockies, but apparently not even the Alaskan or Siberian inhabitants migrate along the Pacific coast. Habit is deeply intrenched in such migratory species; otherwise the Siberian representatives might better winter in southern Asia than to retrace their flight across the inter-continental peninsula, and migrate the whole length of North America to winter in South America. Passing

through the United States they occur commonly from the Atlantic coast to the Mississippi valley, and sparingly westward to Montana (Thorne, 1895; Cameron, 1908), Kansas and Texas. South of the United States the migratory track is not so evident. The A.O.U. Check-list for 1931, Griscom (1932), Forbush (1929), Roberts (1932), et al., state that they migrate along the eastern coastal islands, or the eastern coast, of Central America, a statement not fully verified by specimen evidence. Of the ten or more Central American records for this form only three appear to be from these outer islands, and two of these are of doubtful identity. Apparently they migrate over all of the available routes to South America, by way of the West Indian chain of islands, along the Florida peninsula and across Cuba, by the outer islands along the eastern Central American coast, and particularly over Central America as a whole. (See specimen records, page 278).

Thrushes of this form winter in northern South America, chiefly in Venezuela and Colombia, but occur as far east as British Guiana and southward to Peru. (See winter locality records page 279). They reach their winter quarters by late October, but apparently are not found in the valleys much later than that, seeming to move up into the mountains.

## Newfoundland Gray-cheeked Thrushes

The gray-cheeked thrushes of this singular island habitat, heretofore always regarded as identical with the continental form, constitute the other color phase of the larger race. The discovery of this new color form deserves a few introductory remarks.

During a study of various collections of migrant gray-cheeks it became increasingly evident that they were assortable into two distinct forms, a typical olive-colored form that constituted the bulk of the collections, and a browner-backed form only occasionally represented. The latter were like *aliciae* in size, but in color were like the small, brown-phased *bicknelli*. One of two conclusions seemed inescapable. Either breeding *bicknelli* in New England attained a far larger size than commonly supposed, or else somewhere there must exist a separate stock, of large-sized, brown-backed birds, on undiscovered breeding grounds. Having examined summer specimens from all the known breeding areas between Labrador and Siberia without finding a trace of this puzzling form, the idea of a separate breeding locality began to look dubious. However, in a study of skins at the Museum of Comparative Zoology, I fortunately

had access to Batchelder's splendid collection of Newfoundland thrushes. It was a revelation to discover, almost at glance, that the gray-cheeks from that region represented the breeding stock needed to explain the brown-backed migrants. Some forty-five adult birds of this form, mostly in the Batchelder collection, and all from Newfoundland, seemed for the most part to be distinct from the continental type, even from those just across the Straits of Belle Isle, in Labrador.

**Plumage.** Breeding birds of the Newfoundland type vary from Brownish Olive, which is the migration color of *aliciae*, to Olive-Brown or Sepia. Thus they differ from summer specimens of the continental form by the almost complete lack of grayish suffusion in the dorsal plumage, the gray being replaced by brownish hues. Below, they are similar to the northern gray-cheeks, but with a more buffy appearance on the throat and breast. The bill and tarsus, especially the latter, are inclined to be less dusky, with more yellowish brown.

The belief that the large-sized, brown-backed birds observed in collections of *aliciae* represent Newfoundland migrants is of course purely an assumption, and unfortunately there are no molted August specimens (in winter plumage) from that island to substantiate this view. Nevertheless, a careful comparison of breeding and migrant specimens of both northern and Newfoundland gray-cheeks emphatically demonstrates its probability. Accordingly, then, migrants of this form are slightly browner than breeding specimens, being of a Sepia color or even Raw Umber. If any autumn specimens retain the Brownish Olive of some of the summer specimens, their identity would be lost, since that is the migration plumage of the other form.

Typical breeding specimens of these two forms can be distinguished almost at a glance, the Brownish or Sepia-colored plumage of the Newfoundland birds contrasting plainly with the Grayish Olive of the northern type. Mention has been made, however, of instances of Alaskan gray-cheeks apparently breeding in the Brownish Olive migration colors which are practically identical with one extreme of the Newfoundland plumage. Two of forty-five adult specimens from the island habitat could be almost exactly matched by examples in the continental series and eleven others were hardly separable. Such a range of variation in plumage, with intermediates, would seem to indicate partial intergradation of the two types, or the existence of a bi-phase color condition in Newfoundland but not on the mainland, where specimens from Labrador and Alaska are usually identical.

**Measurements.** Measurements of the Newfoundland gray-cheeked thrush are summarized in Table IV. A comparison of these with those derived for the northern gray-cheek (Tables I, II, and III) clearly indicates that wing length, which is the most important criterion, is practically identical in these two forms. In the tail lengths, however, there is a notable difference, particularly in the males. If treated statistically, as shown in Table V, this difference in retrical length in the males appears to be of slight significance, since the difference contains its probable error 6.46 times; but in the females the difference contains its probable error only 3.77 times, and is therefore of somewhat doubtful statistical significance. As a distinguishing character tail lengths in these two forms are of minor value, since the overlap is nearly complete, but it may possibly be a mutant structural character by which the island type is becoming morphologically differentiated.

TABLE IV

*Measurements of Newfoundland Gray-Cheeked Thrush*

| | SEX | MINIMUM | MAXIMUM | AVERAGE | NUMBER OF SPECIMENS |
|---|---|---|---|---|---|
| Wing Length | ♂ | 98.5 | 108 | 103.1 | 25 |
| | ♀ | 95 | 101.5 | 98.3 | 17 |
| Total Range | | 95 | 108 | 101.2 | 42 |
| Tail Length | ♂ | 66 | 77 | 71.8 | 25 |
| | ♀ | 63 | 72 | 67.9 | 17 |
| Total Range | | 63 | 77 | 70.2 | 42 |
| Tarsal Length | ♂ | 29 | 33 | 31.6 | 25 |
| | ♀ | 28.5 | 33 | 30.8 | 17 |
| Total Range | | 28.5 | 33 | 31.3 | 42 |

TABLE V

*Comparison of Tail Lengths in Newfoundland and Northern Gray-Cheeked Thrushes*

| NAME OF FORM | NUMBER OF SKINS | SEX | LENGTH IN MM. MIN. | MAX. | MEANS | PROBABLE ERRORS | DIFFERENCE BETWEEN MEANS | DIFFERENCE DIVIDED BY P.E. |
|---|---|---|---|---|---|---|---|---|
| Nfld. | 25 | ♂ | 66 | 77 | 71.84 | ± 0.38 | 3.49 ± 0.54 | 6.46 |
| Northern | 28 | ♂ | 63 | 74 | 68.35 | ± 0.39 | | |
| Nfld. | 17 | ♀ | 63 | 72 | 67.94 | ± 0.35 | 2.15 ± 0.57 | 3.77 |
| Northern | 18 | ♀ | 63 | 72 | 65.79 | ± 0.45 | | |

**Occurrence.** Gray-cheeks of this new color form appear to be confined to Newfoundland. The forty-six specimens examined (page 389) came from Custlett, Curslett, Placentia, Bay of Islands, Deer Pond, Nicholsville, Grand Lake, Exploits Bay, Blowme Downs, and Bay St. George. Strangely enough, however, one of the three specimens in the Victoria Memorial Museum from Perce, Gaspé Co., where only Bicknell's thrush would be expected to occur, is almost certainly a Newfoundland bird. Though taken June 14 there is no certainty that the bird was breeding in Gaspé. It may have been a late migrant or a stray bird, especially since Perce is merely across the Gulf from Newfoundland. Its wing is 100 mm., considerably above the maximum for Bicknell's thrush, and its back color exactly matches other Newfoundland birds, which are browner above than typical *bicknelli* from Gulf regions.

A second bird from Perce, however, though a typical *bicknelli* in measurements, seems to show enough brownish in its plumage to suggest possible intergradation with Newfoundland stock. But whether this intermediate-colored bird is merely an extreme variation of the *bicknelli* in the Gulf areas, or the actual occurrence of the brown-phased *bicknelli*, which otherwise has not been found on the northern periphery of its range, or whether it is in any way contaminated with the Newfoundland type cannot be decided without further studies in that region. With only three specimens available very little can be told of the racial status of Gaspé birds.

Mr. Louis B. Gillet, who is making an elaborate study of thrush songs, tells me that the Gaspé thrushes sing exactly as other *bicknelli*, — not only those in other Gulf regions, but all over New England. But the song of the Newfoundland birds, he says, is distinctly different. To the field ornithologist, at least, this is nearly irrefutable evidence that Gaspé thrushes are prevailingly of the *bicknelli* form, and that the Newfoundland gray-cheeks do not regularly inhabit that region.

It seems quite probable, however, that the Gulf *bicknelli*, the Newfoundland gray-cheeks, and the northern gray-cheeks may all come together somewhere in the vicinity of the Straits of Belle Isle, effecting some intergradation. And yet all three forms are reported to be so scarce in these areas, that intergradation, if it exists at all, would be very hard to demonstrate by specimen evidence.

In spite of Batchelder's fine series of skins, which represents the labors of several collectors during two or more summers, Newfoundland gray-cheeks appear to be rather rare. G. K. Noble (1919) was able to get only one of them, though at the same time he secured 30 olive-backs and 15 hermits. Perhaps this form has suffered considerable diminution in numbers since Batchelder's collections were made in 1889 and 1890. The list of migration records (page 390) contains only one specimen taken since 1900. Little is known of the present status of this bird in Newfoundland.

**Migration.** Assuming that large-sized, brown-backed thrushes taken in spring and autumn are migrants from Newfoundland, this form migrates southward in late September and October along the coast of New Brunswick, turning up in small numbers in southern New England in late September. They apparently cross New York harbor and proceed leisurely along the Atlantic coast in company with other gray-cheeks. I have no records for southern United States south of Raleigh, North Carolina, but they probably continue along other gray-cheek routes to northern South America. A number of specimens in the American Museum from Bonda, Onaca, and Valparaiso, Colombia, indicate that they winter in those regions, but the identity of unsexed and rather faded winter specimens is difficult to determine with certainty.

The occasional records of brown-phased birds in the interior are difficult to interpret since both the large and the small brown-phased birds are confined to the east in the breeding season. Such occurrences, however, are not too numerous to be explained as accidental records. There are two intermediate-sized birds of the brown phase in the Chicago

Academy of Sciences from the Chicago region. They are marked as females and have wings of 96 mm. According to the measurement criteria just established these should be gray-cheeks of the Newfoundland type and should be regarded as stragglers. If correctly sexed they are too large for Bicknell's of either type.

In the Museum of Zoology of the University of Michigan is a specimen taken on the Ann Arbor campus which exactly matches the Newfoundland skins with which it has been compared. This also should be considered an accidental record. It had previously been regarded as an olive-back.

## Bicknell's Thrush

The situation relating to Bicknell's thrush is much more complicated. This smaller race, as previously mentioned, is also divisible into two color forms; but, in this case, the two phases exhibit only partial geographic separation. In view of their overlapping distribution, and their evident intergradation on these overlapping areas, as well as the virtual impossibility of distinguishing the phase of the many specimens exhibiting intermediacy, and the fact that their measurements are essentially identical, it will be necessary to consider these two types together in much of the following discussions.

**Measurements.** The distinction of Bicknell's thrush from the larger gray-cheeks rests primarily on measurements. Heretofore available were only those of Ridgway based on ten males and eight females, some (perhaps most) of which were migrants, and one of which may be erroneously identified. The figures now available are based on a much larger series. Following the example set in dealing with the gray-cheeks, only adult birds from the breeding grounds are used, all unsexed skins and specimens whose extremities give evidence of undue shortening being discarded. In the list of specimens examined (page 392) measurements are given for over a hundred additional migrants; but, as previously implied, using migrants in establishing standards would introduce the two-fold error of wrongly sexed specimens and the impossibility of knowing where *bicknelli* leaves off and *aliciae* begins.

TABLE VI

*Summary of Wing Lengths of Bicknell's Thrush*

| SEX | MINIMUM | MAXIMUM | AVERAGE | NUMBER OF SPECIMENS |
|---|---|---|---|---|
| ♂ | 89 | 97 | 93.0 | 31 |
| ♀ | 81 | 95 | 88.1 | 16 |
| Total Range | 81 | 97 | 91.3 | 47 |

Of first importance is length of the wing. In 31 males this varies from 89 to 97 mm. and in 16 females from 81 to 95 mm., with averages of 93.0 and 88.1 mm. respectively (Table VI). Comparison of these measurements with those derived for the gray-cheeks (Table I, page 222) should leave no doubt as to the clear division of these forms into a larger northern and a smaller southern race, with little if any overlap in wing length. The minimum, set at 81 mm. for females, is exceptionally low, and so short a wing does not reappear in over a hundred migrants, though 84 mm. is a fairly common measurement and possibly should represent the minimum. Nevertheless, the 81 mm. is an authentic, repeatedly checked measurement of an unfrayed wing. The possibility of error rests in the slight chance that this particular female, "shot at the nest" on June 25, had previously lost her primaries (and retrices) and that the new replacing ones had not yet attained full length.

The minimum wing length for males, set at 89 mm., might be lowered to 87 on the basis of a few migrants, though the uncertainty of correct sexing militates against it. The maximum for males (97 mm.) is attained only by birds on the northern periphery of their range, where specimens average slightly larger. New England skins have not been found to exceed 96 mm.

Mention should be made, however, of an extreme variant which has been eliminated from these measurements. One of Chadbourne's Mt. Washington specimens, taken July 11, and sexed as a female, has wing lengths of 100 and 101 mm. This is so far above the maximum for Bicknell's thrush of either sex that to make use of such an extreme measurement would ruin criteria for separating the larger from the smaller race. It is a brown-phased specimen, but the possibility of its being a stray Newfoundland bird seems rather remote. In other measurable features this bird is entirely within the size limits of the smaller form and it seems best to regard it as an extreme variant in wing length.

Tail length is the next best measurement for separating the two size races, but is much less diagnostic than the wing. Not only is it a more variable structural feature, but it is more subject to error in measurements. Males were found to vary from 60.5 to 69 mm., averaging 65.2 mm., and females from 55 to 67 mm., averaging 62.2 mm. (Table VII).

TABLE VII

*Summary of Tail Lengths of Bicknell's Thrush*

| SEX | MINIMUM | MAXIMUM | AVERAGE | NUMBER OF SPECIMENS |
|---|---|---|---|---|
| ♂ | 60.5 | 69 | 65.2 | 26 |
| ♀ | 55 | 67 | 62.2 | 16 |
| Total Range | 55 | 71 | 64.7 | 42 |

The 55 mm. minimum tail length is a slightly exaggerated measurement for the dwarf specimen mentioned above, but since several migrants had tails of 56 and 57 mm., the smaller length was not rejected. Comparison of the measurements in Table VII with those for the gray-cheeks (Table II, page 222) indicates differentiation, but with considerable overlapping.

The tarsal lengths in the two sexes of Bicknell's thrush are practically identical. The range is 27.0 to 32.5 mm. with an average of 29.6 mm. (Table VIII).

TABLE VIII

*Summary of Tarsal Lengths of Bicknell's Thrush*

| SEX | MINIMUM | MAXIMUM | AVERAGE | NUMBER OF SPECIMENS |
|---|---|---|---|---|
| ♂ | 27 | 32.5 | 29.6 | 31 |
| ♀ | 28 | 31 | 29.4 | 16 |
| Total Range | 27 | 32.5 | 29.6 | 47 |

Comparison of these figures with those for the gray-cheek thrush (Table III, page 223) indicates that tarsal length is of very little diagnostic importance; it differs so slightly in the two size forms that it is in no wise dependable as a distinguishing character.

The bill, with its length varying between 11 and 14 mm. in both *aliciae* and *bicknelli*, likewise seems to have no taxonomic value, although Ridgway and other early ornithologists tried with indifferent success to make use of the narrowness and decurved (cinclid) character of the culmen as a distinguishing character for the smaller form. The cinclid feature of the bill is at best of infrequent and sporadic occurrence, and its depth and width (or slenderness) appear to possess no diagnostic dependability.

Weights, as indices of size differences, would probably be helpful in separating Bicknell's from gray-cheeks, but there are very few weights available. Those few are listed in Table IX. Such a small series, however, does not indicate whether or not weights would be a dependable criterion of subspecific differences. Probably weights vary more with a bird's physical condition than does wing length. Nestlings average about 24 grams at the time they leave the nest, but fluctuate considerably due to differences in feather growth.

TABLE IX

*Weights of Gray-Cheeked and Bicknell's Thrushes*

| SPECIES | SEX | WING LENGTH IN MM. | WEIGHT IN GRAMS | LOCALITY | DATE | CONDITION OF BIRD |
|---|---|---|---|---|---|---|
| *Gray-cheek* | ♂ | 105-7 | 30 | Guatemala | Apr. 28 | Fat |
| *Bicknell's* | ♂ | 92 | 29 | Mt. Mansfield | Sept. 6 | Molted juvenile |
| *Bicknell's* | ♀ | 91 | 27 | Mt. Mansfield | Aug. 13 | Beginning to molt |
| *Bicknell's* | ♀ | 84 | 24 | Mt. Mansfield | July 10 | Worn, breeding |

**Plumages.** Bicknell's thrushes can often be distinguished from other gray-cheeks by color characters, but to do so requires consideration of

many complicated features. Attempts to use color in such identifications has led to considerable confusion, due, of course, to failure to comprehend the various phases involved.

One color form of Bicknell's thrush has the Brownish Olive summer plumage so nearly identical with the fall and winter plumage of the northern gray-cheeks. Breeding specimens of the two size forms can be readily separated by the predominant grayness of the larger birds; but after the postnuptial molt the two become practically indistinguishable, the smaller form sometimes being separable by a brighter brownish olive suffusion, particularly on the wings and tail. The latter character must be used with caution, however, because age differences, at least in part, determine the amount of brownish evident on the wings of both forms. Ventrally, these birds resemble the gray-cheeks, and variations in spotting have never been suggested as having possible taxonomic significance. The amount of buff about the breast and face seems to be correlated with the dorsal colors, browner birds usually having more buff, and grayer birds lacking it. There is a pronounced change in molted northern gray-cheeks, but only a slight change in the smaller form.

It is convenient to refer to this color form as the olive or gray phase, although, strictly speaking, Ridgway's Olive is much too greenish to match specimens. Nevertheless that author referred to this plumage as plain olive. Nor are the specimens gray, but merely distinguished from the brown-phased *bicknelli* by being grayer.

The second color phase of Bicknell's thrush may conveniently and quite accurately be referred to as the brown phase, so well illustrated by specimens from the Catskill Mountains. Ordinarily it is a Sepia color, or nearly Raw Umber, but it varies considerably in the direction of the olive phase, either through actual intergradation, or through mere range of color. Exaggerated examples of these two phases of Bicknell's can be separated at a glance when dealing with specimens, and with close observation can sometimes be correctly identified in the field. But in a large series of specimens the two color types can be completely bridged by intermediates, thus making many skins virtually unidentifiable in respect to phase. During the postnuptial molt, if they change color at all, specimens of this phase may become a little browner.

### *Distribution of Phases*

The geographic occurrence of the two color forms of Bicknell's thrush suggest some segregation into northern and southern types, but their

distribution as a whole is too poorly known to draw any definite conclusions. The olive phase appears for the most part to be genetically pure in the northern part of its range in the Canadian provinces. Five specimens from Canadian Labrador, three from the Magdalen Islands, and six from Seal Island are all unquestionably of the olive type. More specimens should be taken to verify the absence of the brown-backed birds, but the fourteen skins form a fairly convincing series. Contradictory evidence furnished by one or two Gaspé specimens of somewhat intermediate coloration weakens this belief, but since they are not definitely brown-phase birds, and, since their affinities may be Newfoundland instead of New England, further allusion to them is suspended.

On the other hand, only the brown-backed phase has so far appeared on the southern periphery of the range, but the specimens examined are entirely adequate for proving that the olive phase does not exist there. The Catskill type, from the southernmost part of the range, is very brown indeed. The other two specimens collected by Bicknell in the same region are said to be identical with the type, although Brewster (1883) intimated that one of them was a little variable. The one specimen available from the Berkshires is also brown. If others have been taken there, as rumored, all attempts to run them down have proven unsuccessful. One bird from Mt. Moosilauke, the southernmost record for New Hampshire, is likewise of the brown phase. Two birds from Killington, the southernmost specimens from Vermont, are too intermediate in coloration to be definitely considered as the brown-phase type.

In the Mt. Mansfield region of central Vermont, however, and in the Presidential Mountains of central New Hampshire, both phases are found to be well established, sometimes in approximately equal numbers. Of nine adult specimens from Mt. Washington, five appear to be referable to the brown type and four to the olive. Other regions in the Presidential Range are not sufficiently represented by specimens to permit drawing conclusions; four skins from the Carter Mountains and one from Mt. Madison appear intermediate. In the Mt. Mansfield region the olive phase is certainly more abundant, as is clearly indicated by both specimens and observations. Nine of the thirteen adult specimens from Mt. Mansfield are olive, two are brown, and two I call intermediates or intergrades, — one inclining toward brown, the other toward gray or olive, thus seeming to bridge the gap between the phases. All of my six adult specimens are of the olive type.

### *Nesting Studies in Relation to Phases*

On Mt. Mansfield last summer (1935) some detailed nesting studies were carried out with both phases of birds. Persistent attempts were made to ascertain whether or not, and to what extent, the color phases interbreed; but unfortunately many of the nests were broken up before the identity of the males could be satisfactorily determined. At five nests the mated birds were quite definitely of the same type (four olive and one brown), and at four others (three olive and one brown) I believed they were, but was somewhat uncertain of the male. At the four remaining nests (three olive and one brown) the status of the male was unknown. Of course if the color type differences were only phases, as ordinarily understood, they would be expected to interbreed freely. The fact that they did not appear to interbreed in these studies does not necessarily indicate voluntary segregation, because the greater abundance of the olive-colored birds would provide greater chances that one of them would mate with another of its type. The scarcer, brown-phase females, then, might be expected to mate with the other type; but in two of the three cases studied they did not *seem* to do so, and in the third case the male was unknown. Thus, this nesting evidence suggests a tendency for the two phases to mate apart, but the observations are entirely inadequate for definite proof.

Special efforts were made to determine whether there were any nesting or ecological differences in the two types; but the only noticeable difference was the tendency of the eggs of the olive form to be nearly immaculate. They were usually greenish blue only faintly wreathed with a light sprinkling of brownish spots, whereas the eggs of the brown-phase birds were, in all cases, more heavily spotted with brown. The eggs of the former were not uniform, however; and sometimes two or three would be nearly plain with the other egg of the clutch more thickly spotted. Otherwise, no life-history differences at all were detectable; there was no constant difference in breeding elevation, in types of habitat chosen, in nests, nest structure or nesting habits. Nothing about them except the slight difference in color of the adults and the spotting of the eggs would suggest any inherent difference in the birds.

## Summary of Color Phases in Gray-cheeked Thrushes

Thus there are four more or less distinct color forms among the gray-cheeked thrushes — a large gray (northern) and a large brownish to olive

(Newfoundland) form, and a small olive and a small brown form (both Bicknell's thrush). Typical examples of the breeding plumages of all four are quite readily distinguishable, but the smaller two may show complete intermediacy. At the postnuptial molt in August all forms change plumages; but the fall and winter colors of the two smaller ones differ only slightly from the summer dress. Therefore we are actually dealing, not with four, but with eight separate plumage types, none of which are very dissimilar, and some of which are practically identical. Moreover, as already intimated, first year birds differ slightly from the adults, not only in the tear-shaped, buffy spots so characteristic of immaturity in this group of thrushes, but also in the brownish wash on the juvenile remiges and retrices, which are retained until the end of the second summer. This difference is largely masked in the browner phases, but noticeable in the grayer ones. This adds two (or four) types to the eight already mentioned. And finally, of course, there is a great deal of intermediacy between all of these divisions.

Nevertheless, by resorting to both measurements and color characters, most of these types can be separated out more or less satisfactorily by the following scheme, guarding against sexual differences in measurements and immaturity variations:

Northern gray-cheeks: ♂ W. 98–108; ♀ W. 95–104 (inclusive)
- Breeding plumage — Grayish Olive
- Migration plumage — Brownish Olive

Newfoundland gray-cheeks: Measurements as above.
- Breeding plumage — Olive-Brown
- Migration plumage — Sepia

Olive phase *bicknelli:* ♂ W. 89–97; ♀ W. 81–95 (inclusive)
- Breeding plumage — Brownish Olive
- Migration plumage — A little brighter, less gray

Brown phase *bicknelli:* Measurements as above.
- Breeding plumage — Sepia to Raw Umber
- Migration plumage — A little browner

## Taxonomic Considerations

It should now be clear that the larger subspecies, known as the gray-cheeked thrush, is divisible into two color forms, a northern gray-backed form breeding from Labrador to Alaska, and a browner-backed type inhabiting Newfoundland. These two forms, as already emphasized, appear to be geographically separated, except possibly in the vicinity of the Straits of Belle Isle. The peculiar fauna and flora of Newfoundland,

already known to exhibit a high degree of subspecific differentiation, illustrate many stages in the evolution of biological forms. Its avifauna includes a number of unique races confined mainly to the island, some of which are distinct and readily recognizable, some of which show only minor variations hardly deserving racial recognition. In the present circumstance, however, it would seem that the Newfoundland gray-cheeked thrush is not sufficiently distinct from the mainland type to justify separate subspecific recognition.

The two similarly-colored phases among Bicknell's thrushes, which at first glance would appear to parallel the preceding situation, perhaps possessing the same evolutionary explanation, show even less clearly the division into two forms. This dichromatic condition in Bicknell's thrush is now known to a number of ornithologists, but the taxonomic rank by which the color forms should be designated is a matter of some disagreement. Some would regard them as separate races on the basis of a few distinct specimens from the northern and southern parts of the range, assuming that the coincident occurrence of both types in New England is subspecific intergradation. Others are not willing to recognize as separate races forms which intermingle geographically to such an extent as these forms seem to, and would regard them as mere color phases of a single geographic race. A few have even proposed specific separation; but in consideration of the fact that the two types show only a relatively slight color difference, that their songs and nesting habits are precisely alike, and that they probably intergrade to a considerable extent, the view that they represent separate species seems out of the question. The olive-back and the gray-cheek, which possess different characters, different songs, and different nesting habits, are regarded as closely related species. If the two phases of Bicknell's thrush, which appear to have no critical differences in these respects, actually represent separate species they must be closely related indeed!

The writer's conclusion is that the evidence for recognizing these color types as separate subspecies is inadequate. They are well known from only a limited part of the whole range. Outside of this region there are too few specimens to be certain that the color types are really geographically separated. Moreover, there are certain areas, such as the Adirondacks and the mountains of Maine, where the color status of inhabitants is entirely unknown. Careful observations on nesting birds in an area where both types and intermediates occur revealed no significant differences in song, habitat, or nesting habits, and although closer study of the

birds in the extremes of the range might disclose unsuspected differences, the few present reports of observers make this seem unlikely. Since this leaves only a relatively slight color difference as the means of separating the two forms, they had best for the present be regarded simply as color phases. Further study, the writer believes, may reveal that two potential races are involved, but that they are not as well-marked as most recognized subspecies.

## Nomenclature

### *Nomenclatural History*

The species name *minima* dates back to 1848, when Frederic Lafresnaye (1848), on the basis of a single winter specimen from Bogota, Colombia, described a new form of North American thrush, applying to it the name *Turdus minimus* because of its small size. A description of the new thrush, appearing in the January number of *Revue Zoologique* for that year, gave a technical account of its distinguishing characters in Latin, followed by a few remarks in French. The measurements given indiscreetly omitted the wing length. Except for a few other early South American specimens questionably referred to Lafresnaye's type, the description of the new form seems to have been largely ignored, and Prince Charles Bonaparte soon united it with *Turdus minor* (then the name for the olive-backed thrush), from which Lafresnaye considered it distinct (Sclater, 1854). Consequently, this new form, together with all the dubious examples referred to it, was subsequently by common consent set down among the synonyms of the olive-backed thrush, where it remained buried in oblivion for more than seventy years.

Ten years later, in 1858, Baird described *Turdus aliciae*, the gray-checked thrush, on the basis of the two Kennicott specimens from Illinois and four additional migrants from Missouri (Baird, 1858).

Twenty-three years later, in 1881, E. P. Bicknell surprised eastern ornithologists by his startling discovery of a hitherto unknown thrush apparently breeding in the Catskills, close to America's largest metropolis and close to the stamping grounds of many bird-minded biologists (Bicknell, 1882). Specimens submitted to Ridgway were promptly described as southern, subspecific representatives of Baird's *Turdus aliciae*, and accordingly became known as *Hylocichla aliciae bicknelli* in honor of their discoverer (Ridgway, 1881). The change in generic name resulted from the removal of the North American woodland thrushes

from the Old World genus *Turdus* and the erection for them of the new genus *Hylocichla* (Baird, 1864).

This new Bicknell's thrush retained its nomenclatural stability for nearly forty years. Then in 1919, Outram Bangs, in going over a series of old skins in the Museum of Comparative Zoology, chanced upon Lafresnaye's neglected *Turdus minimus*, which, as already mentioned, had long been lost in synonymy. Critical comparisons, Bangs reported, indicated not only that it was a gray-cheek and not an olive-back, but that it was "an extreme example of the southern form . . . always known as *Hylocichla aliciae bicknelli*." (Bangs and Penard, 1919). Accordingly the long-established name for Bicknell's thrush had to be changed on priority grounds, Lafresnaye's *minimus* antedating Ridgway's *bicknelli* by thirty-three years. The two forms thus reached their present status: *Hylocichla minima minima* (Lafresnaye), the Bicknell's thrush, and *Hylocichla minima aliciae* (Baird), the gray-cheeked thrush.

### *Necessary Nomenclatural Changes*

Continued study of this situation, however, and careful examination of Lafresnaye's type on the basis of a new standard of measurements established on many times the number of specimens used heretofore, clearly indicate that the type of *minima* is not a Bicknell's thrush, but simply a winter specimen of the larger form, long known as *aliciae*. Consequently another inconvenient change of names is necessary. To call attention to this error in identification, made by one of the best systematic ornithologists of recent times, is doubly unfortunate, both because of the complications thus introduced, and because of the unpleasant necessity of correcting a great taxonomist. And furthermore, at the time of Bangs rediscovery of Lafresnaye's old type, his determination was confirmed by some of America's ablest ornithologists, to whom the type was submitted in order that its identity might not be questioned. It may therefore seem imprudent and unavailing to raise any question regarding Lafresnaye's nearly century-old *Turdus minimus*.

It must be remembered, however, that at the time of Bangs and Penard's restoration of this type the status of the gray-cheeked group of thrushes was but imperfectly understood, and the only standard of measurements available for identifying them had necessarily been set up on an inadequate series of specimens. Strangely enough, neither Bangs nor any of his supporters published any measurements to verify their identification. Now that this specimen has been examined the formerly

vague statement that Lafresnaye's bird was "an extreme example" of Bicknell's thrush takes on a clearer meaning. The publishers apparently meant "extreme" in the sense that it was on the border line between the larger and smaller form, but in favor of the smaller. If they measured the wing, which is the only reliable criterion for identification of that skin, they must have used the left one as it is 97 mm. in length and represents the maximum length for males of Bicknell's thrush. But the type specimen is unsexed, and, moreover, the left wing is obviously broken at the tip. The right wing, which is entire, measures fully 99 mm. and thus is considerably above the maximum for Bicknell's thrush. It has already been noted in the measurements on the northern gray-cheeks that wing lengths in the female run from 95 to 104, with an average of 98.8, and in the males from 98 to 108 with an average of 103.2. Regardless of sex then, the type specimen must certainly be a gray-cheeked thrush of the larger form. Though migrants and winter specimens might conceivably have slightly longer wings due to their relatively unfrayed condition, the type is still too far above the critical dimensions to allow misinterpretation. Consequently the possibility of this specimen representing "an extreme example" of Bicknell's thrush seems very remote.

Tail measurements, as already pointed out, are too variable with too much overlapping to be a very valuable criterion; but it is noteworthy that the tail of the type is even *above the average* for the *larger form*, in spite of its somewhat frayed condition. Female retrices were found to average 65.8 mm. and males 68.4, whereas the type's tail, though difficult to determine with certainty, was close to 69.

The tarsal length is typically gray-cheek, measuring slightly larger than the average for the smaller Bicknell's. It is 30 mm., the average for Bicknell's being 29.5, that of the larger form 30.2. (There is no significant sexual difference in tarsal lengths.)

One additional point of testimony can be brought to bear on the identification of the type. It is a matter of common knowledge that a northern subspecies in general winters farther south than the southern representatives of the same species. The type is a winter specimen from Bogota, Colombia, which is near the southern extreme of the wintering range of the gray-cheeks. The winter quarters of Bicknell's thrush might be expected to lie north of this, — and that seems to be the case, all the authentic winter records for the smaller form coming from the Island of Haiti. In spite of the Check-list and other authorities there are still no well-substantiated records of Bicknell's thrush occurring in South America.

Even having established the identity of the type as a gray-cheek rather than a Bicknell's, there still remains the perplexing question of whether it is a northern or a Newfoundland gray-cheek. It is now nearly ninety years since it was collected and though a reasonably good specimen for its age, it has been made over into a study skin, after having been mounted and thus exposed to light. Yet even after making due allowance for post-mortem fading, the specimen can probably be accurately classed, surprisingly enough, with the rarer brown-backed series of Newfoundland birds. In fact its brownish color provides a partial alibi for its having been misidentified as Bicknell's thrush in spite of its size. This decision as to its color, however, is not an especially important one, since the Newfoundland birds are here regarded as a mere color phase. But if separate subspecific rank is later proposed for the Newfoundland birds, as is conceivable, then this issue will again come to a head.

Thus it is evident that the present scientific name for Bicknell's thrush, *Hylocichla minima minima* (Lafresnaye), can no longer be correctly applied to that form, but henceforth must be used to designate the gray-cheeked thrush, reducing the long-established *aliciae* to synonomy. Such a change is singularly unfortunate, not alone because the term *minima* must now be applied to our next to *largest* hylocichlid thrush, but because the well known name, *aliciae*, which has stood unchanged for more than 75 years, must be discarded in favor of a name formerly applied to the race with which *aliciae* has so often been confused. All of the names for this species group, moreover, must be based on an unsatisfactory type, whose color characters are obscured, and whose identity may even yet be a future bone of contention among systematists. Our present system of nomenclature does not permit rejecting this century-old and historically complicated type, — which of course would be a very convenient thing to do, not only for the sake of retaining the former names of *aliciae* and *bicknelli*, but also for the sake of eliminating uncertainties.

Reidentification of Lafresnaye's bird which has recently stood as the type specimen of Bicknell's thrush, deprives the latter of both type specimen and name. Obviously, Ridgway's term *bicknelli*, rejected in 1919 as a result of Bangs rediscovery of Lafresnaye's *minimus*, must now be restored to Bicknell's thrush, the type for which is the one originally designated by the describer, now No. 95545 in the U. S. National Museum. It is a brown-phase bird from the Catskills.

Accordingly the names of these forms as here interpreted are as follows:

1848. — *Hylocichla minima minima* (Lafresnaye). — Northern and Newfoundland gray-cheeked thrushes.

Type specimen. — Museum of Comparative Zoology, No. 76498; unsexed; type locality, Bogota, Colombia.

Synonym. — *Hylocichla minima aliciae* (Baird), 1858.

1881. — *Hylocichla minima bicknelli* Ridgway. — Bicknell's gray-cheeked thrushes.

Type specimen. — U. S. Nat. Mus., No. 95545; male; type locality, Slide Mt., Ulster Co., New York; collected by E. P. Bicknell, June 15, 1881.

## PART II

## DISTRIBUTION AND MIGRATION OF BICKNELL'S THRUSH

### Introduction

This section, dealing with the distribution of Bicknell's thrush, consists of a detailed analysis of all the available locality records for the smaller form. To this consideration of distributional data is appended a summarizing list of specimens, arranged by states and provinces, giving localities, dates, and measurements for all the specimens examined, and adding other records with whatever data is available (page 392). A study of this list should give a clear (though incomplete) picture of the breeding limits, migration routes, and winter quarters of these birds. The measurements given are an index to the reliability of the specimen records. Sight observations have necessarily been eliminated except on typical breeding grounds, where, curiously enough, records based on song or call notes are often more trustworthy than specimen identifications outside those areas.

Distributional data of this sort can be presented most advantageously by separation into three natural divisions: (1) breeding range, (2) migration records, and (3) winter distribution. The account of these records is intended primarily as a source of reference.

### BREEDING RANGE

#### *Gulf of St. Lawrence*

From the North Shore of the Gulf of St. Lawrence, provincially known as the "Canadian Labrador," come the northernmost records of Bick-

nell's thrush. Specimen evidence of this was first secured by Townsend, who collected a female at Cape Charles, July 28, 1906, and a second female at Grand Romaine, July 8, 1915. Though recorded as *aliciae*, Townsend adds, "The measurements of this and two other specimens from the Labrador Peninsula suggest Bicknell's Thrush . . . but a study of a larger series is needed to determine the status of this bird in Labrador" (Townsend 1917). The additional specimen referred to is a typical gray-cheek from Esquimaux Point. Still earlier Townsend and Allen (1907) had suggested that a series of thrushes from Labrador would throw light on the standing of *bicknelli*. Austin (1932) stated that there is much intergradation between *aliciae* and the New England form *minima*. This probably is not strictly true, but that impression may result from the lack of information as to where one form leaves off and the other begins.

The most substantial and convincing evidence of the occurrence of the smaller form in the Canadian Labrador, however, comes from Mr. W. E. C. Todd's three breeding males taken in this region, one in 1917, and two later in 1928 (by G. M. Sutton). Mr. Todd (unpublished) has recognized for some time that the breeding birds in this and other Gulf areas are referable to the smaller form and that *aliciae* does not occur there.

Gillet (1935) found the singing thrushes at La Tabatiere, on the North Shore, to be prevailingly Bicknell's, singing the same song as the birds in the Catskills and White Mountains; but in Newfoundland he was greeted by a new and different refrain.

Dr. Lewis, in a letter, writes that this form "is a not uncommon bird in summer, presumably breeding from Kegashka (long. 61° 16′ W.) eastward"; but west of Kegashka he has not observed it in summer.

Taverner adds, in a letter, that he believes the birds in Canadian Labrador to be Bicknell's, but has never been able to get specimens for substantiation. One summer he collected intensively from Moisie to Natashquan without securing a single specimen of this form. However, Natashquan, although the region from which one of Todd's specimens came, is slightly west of Lewis' western limit, and it may well be that, as the five specimens also indicate, Bicknell's thrush occurs only eastward from Natashquan on the North Shore.

Bicknell's thrush is also known to inhabit the Gaspé Peninsula. The only specimen evidence of this rests in Taverner's two birds taken at Perce, Gaspé County, July 16, 1914, and June 4, 1915. Apparently a set of eggs was also collected there July 20, 1915. A third specimen taken at

Perce proved to be a Newfoundland gray-check (see page 227). Taverner adds that the smaller form also probably inhabits Miscou Island, across the Bay of Chaleur.

Demille (1926), under *aliciae*, records "one seen at the forks, July 8, and another at Grand Vallée."

Professor V. C. Wynne-Edwards writes that he is familiar with what he believes to be Bicknell's thrush in the Skikshok Mts., Gaspé, where they are fairly common above 3000 feet. The song of these birds resembled that of New England Bicknell's and differed noticeably from that of the gray-cheeks in the vicinity of Battle Harbor.

Gillett (1935) reports them from Perce, ". . . round the top of Mont Ste. Anne, and at the Portage of Grand Greve their song travels down to you from the wooded brow of the highest mountain walls beetling over the sea on that frontier coast." He remarks their occurrence at high elevation in Gaspé, finding them at sea level only in Labrador.

The presence of Bicknell's thrush as a part of the breeding avifauna of the Magdalen Islands is likewise unequivocal. This was first demonstrated by Dr. L. B. Bishop, who collected a specimen on Grindstone Island, July 15, 1887. Though recorded under *aliciae* the measurements given are clearly those of the smaller form. Dr. Bishop writes (in a letter) that he considered this bird an intergrade and took it to an A. O. U. meeting for identification where he lost track of it. At the meeting Bicknell's thrush was selected as a problem for study during the ensuing year, but no one studied it. The specimen referred to is now in the United States National Museum, with the gray-cheeks, although of course it is typical Gulf *bicknelli*. Other birds were observed on the island in a thick grove of spruces, apparently breeding.

Better evidence of the occurrence of this form in the Magdalens rests on Todd's unpublished records of two specimens collected there by himself on June 27 and 28, 1901.

Gray-cheeked thrush was on Mr. Bolles' list of Cape Breton summer birds (F. H. Allen, 1895), but apparently he made no attempt at subspecific identification, nor did he state whether it was a migrant or resident. If it were migrant, (providing it was correctly identified) it may have been either the gray-cheek or Bicknell's, and if resident at the Cape it should have been the latter. Pending further information relating to this or new records from Cape Breton, (which probably will not be forthcoming), Bicknell's thrush must be regarded as only a hypothetical possibility on that Island.

In a recent letter Taverner remarks, "In a collection we have made this summer (1935) in northern Cape Breton, Gray-cheeks are conspicuous by their absence."

Aside from these rather scanty records, there seems to be no evidence of Bicknell's thrush in the Gulf region. In view of intensive collecting and observations centered about these areas, it may be concluded that this form is both scarce and peculiarly local in its distribution there. Why it should occur east of Kegashka and not west, or inhabit the Magdalens and Gaspé, but not the Gulf Coast of New Brunswick, Cape Breton, or Prince Edwards Island is perhaps an unanswerable question. One might venture three suggestions: (1) either they are recent invaders of the northern boundary of their range, and not yet well established; or (2) their reproductive efficiency is too low to result in spreading, thus creating small colonies; or (3) they are limited by their peculiar habitat requirements, such as excessive mists, evergreen groves, special altitude or a suitable equivalent, and cannot inhabit regions not providing these special conditions.

### *Seal Island*

In 1884 Rev. J. H. Langille discovered Bicknell's thrushes on Seal Island (and to a less extent on Mud Islands), an evergreen, fog-bound island off the southwest end of Nova Scotia, and since then this place has become the mecca of ornithologists in search for this evasive bird in its summer home. Langille (1884, 1892) himself reported it very abundant, and his account of these interesting birds, written in that author's own inimitable way, still remains one of the best contributions on their habits. Its one regrettable feature is the unfortunate omission of pertinent facts that he might have added. The specimens supposedly collected have never come to light.

Apparently H. E. Meyer secured a nest with eggs from Seal Island, June 3, 1901, since Reed (1904) describes the nest and eggs of this form on the basis of material provided by that collector.

In the summer of 1904 A. C. Bent (unpublished field notes) spent four days (July 3–6) on Seal Island, and found Bicknell's thrushes very abundant and noisy. Present at a time when the young had left the nests and were apparently fully grown, Mr. Bent found the thrushes very tame, evidencing unmistakable signs of curiosity and friendliness, since they would come close, within 15 or 20 feet, and talk to him. As soon as he made his appearance in their shadowy domain of spruces they would

come flying toward him with soft whistles. A dozen or more unoccupied nests were located and several specimens collected. One of the skins is now in the Sanford collection at the American Museum, and two others are at Cambridge.

H. K. Job (1905) alludes to a visit to this island by writing "not the least interesting of the Seal Islanders is the demure little grayish brown fellow, with the white and spotted breast, the Bicknell's Thrush. We met them everywhere in the woods; they stand on a branch in a thrush-like attitude and chirp, then flit on a little further and again watch."

On June 29, 1906, H. F. Tufts collected two specimens of this form on the Island (Thayer collection). The following June, 1907, at the instigation of John Thayer, he made a second trip to the Island with the intention of securing a few nests. Though the owner of the Island discouraged collecting, protesting that the thrushes were becoming yearly more scarce, Mr. Tufts was finally permitted to collect the three nests he managed to locate. Unlike Mr. Bent, he found the thrushes wary and suspicious, and the nests very difficult to find. Two more specimens were collected (Tufts, 1909; Thayer, 1907).

Curiously enough, in spite of this populous colony of Bicknell's thrush on Seal Island (and to a less extent on Mud Islands), it appears to have been observed but rarely in other Nova Scotian regions. Chesley Allen (1916) says that it was "Found only in one locality about Yarmouth, as far as my observations are concerned. A number of them summer on West Cape near the mouth of the harbor, and probably nest there." Lewis (1920) also found them there several years later, June 18, 1920. In a letter he adds that he has seen them in summer on Cape Forchu, (which is probably the West Cape referred to above, since it is the Cape on the west side of the entrance to Yarmouth Harbor).

Bryant collected a male at Yarmouth on July 8, the indefinite locality suggesting it also may have been from the Cape. The specimen is in the Museum of Comparative Zoology.

As in the Gulf breeding areas, the spotty distribution of this form in Nova Scotian regions is difficult to explain. It appears not to inhabit the mainland at all; and of the many hundreds of islands opposite Yarmouth Harbor and dotting the Bay of Fundy, only those mentioned are known to be inhabited. Gross, Pettingill, and others have made intensive studies of the avifauna of Grand Manan, Kent Island, and other insular as well as coastal areas of Maine and New Brunswick, but have never found this thrush. Why the supposedly abundant birds on Seal Island

do not spread to other islands is one of the enigmas in the distribution of this form.

Two of the suggestions ventured to explain their limited occurrence in Gulf areas may apply here. Certainly the highly specialized habitat requirements of this form have much to do with its discontinuous distribution. Only evergreen-covered islands, exposed to constant mist and fog, and perhaps possessing other unknown but essential features, seem to be suitable. And yet in view of the probable abundance of just such islands this suggestion alone seems hardly applicable. A low reproductive or breeding capacity, coupled with high mortality, might be a better explanation. Tufts (1909) noted that the Bicknell's thrushes on Seal Island had several destructive enemies to overcome during the nesting season — the abundant crows and ravens, which constantly circled over the island, and feral cats, which had been liberated and were breeding wild in considerable numbers. Thus it may well be that the thrushes on the island are barely able to hold their own, or may even represent a decreasing population, therefore not spreading to other areas. The early tales of their abundance on this paradise have long since ceased to be current. The island now, I am told, is a sanctuary, still inhabited by some Bicknell's thrushes, but no one seems to have commented on their status there since Tuft's visit in 1907. Possibly the introduction of cats has had much to do with their alleged diminution in numbers.

It may be added that during the summer of 1935 Mt. Mansfield's breeding population of Bicknell's thrushes (on a basis of 13 nests) was found to have a reproductive efficiency of only 25 per cent. Although the birds seemed to be resourceful in safe-guarding nest and young against the most inclement weather conditions, other decimating factors, including infertility, defective embryos, and, above all, predators combined to effect a mortality of 75 per cent up to the time of leaving the nest. Considering in addition such factors as juvenile mortality, adult losses, and non-breeding birds, the thrush population is at best only a replacing, and perhaps even a decreasing one. Such circumstances, together with the facts that they lay three eggs oftener than four and seldom attempt a second brood, suggest that their low breeding efficiency may be a more serious limiting factor than specialized habitat requirements, — especially in sea-level, maritime regions where there appears to be ample room for spreading.

* * *

Although in the Canadian maritime provinces Bicknell's thrush is

chiefly confined to sea-level coasts and islands, in the United States it is a strictly montane bird, occurring nowhere except at relatively high altitudes on the highest mountains. New England peaks, representing the long-eroded and glacier-worn stumps of a pre-Silurian upheaval, range from 2000 feet to a little over a mile in altitude. Bicknell's thrush apparently does not occur at all on mountains much lower than 3000 to 3500 feet in elevation, and on the higher peaks finds its optimum zone between 3000 feet and the limit of trees. Scattered pairs may be found breeding as low as 2500 feet on some mountains. The zone occupied is typically sub-Canadian, comprising dense coniferous stands of balsam and spruce, mingled with birch. Though tall stands of timber may characterize the 3000 foot zone, upwardly it merges into the matted, stunted, storm-blasted shrubbery typically featuring alpine summits. On some of the southern mountains, however, where coniferous elements are largely lacking, the thrushes are said to inhabit deciduous groves (Eaton, 1926).

### *Maine*

The mountains of this state, consisting of a few scattered and isolated peaks, mainly near the New Hampshire border, are evidently not a very favorable habitat for Bicknell's thrush. The bird does exist, however, on the three peaks that have been investigated, and probably extends its range to some of the others. In view of the paucity of information relating to the avifauna of the mountains of Maine, next to nothing can be determined concerning its quantitative status there.

The first record of the occurrence of Bicknell's thrush as a breeding bird in Maine is reported by F. H. Allen (1898) who encountered at least five birds in song on Mt. Katahdin, June 22–23, 1897. The summit of Katahdin, Maine's grandest mountain, is a boulder-strewn, wind-swept, treeless area without adequate vegetative cover for thrushes. These birds were noted only along the Southwest Slide. No specimens were taken, or even mentioned as seen, but Mr. Allen was well acquainted with Bicknell's thrush at that time and could hardly have mistaken its song.

Sweet (1906) found Bicknell's thrush singing on Mt. Abraham, June 22, 1906. He gives a careful and unmistakable description of their song and call notes. On September 20th of that summer he returned and heard their call notes in all directions both in the forenoon and afternoon.

Perkins (1922) records this bird for Mt. Bigelow (3800 feet). No specimens were taken but the birds were observed in an area where one would

expect only this form to breed. The time was July 13, 1921. When he returned on August 1, with G. M. Allen, there was no sign of the thrushes; but they are normally very quiet at this time of the summer.

Gross writes he has seen the bird on Mt. Katahdin.

The belief of some early ornithologists that the breeding birds of northern Maine might be the northern gray-cheeks is of course out of the question, though there are no specimens to prove it.

*New Hampshire*

The mountains of northeastern United States reach their greatest height in the Presidential Range of the White Mountains, with the highest, Mt. Washington, attaining an altitude of 6,293 feet. This region may possibly represent the optimum range in the distribution of Bicknell's thrush, but census work is so far insufficient for demonstrating this. More breeding localities have been reported from the White Mountains than from other areas of similar size, but these peaks have undoubtedly received much more attention than the Green Mountains or Adirondacks. New Hampshire's peaks are higher and balder than those of its sister state, but they are somewhat more scattered and not nearly as extensive. Whether or not they actually afford more suitable breeding grounds for the birds in question is a matter awaiting further investigation.

The known summer haunts of Bicknell's thrush in New Hampshire are referred to below in the order in which they were recorded.

The occurrence of Bicknell's thrush in New England was first demonstrated by Brewster (1883) on Mt. Washington, soon after it had been reported from the Catskills. Although Bradford Torrey apparently suspected still earlier that a gray-cheeked thrush summered in the White Mountains, the fact was not verified until Brewster disclosed its presence on Mt. Washington, July 19–20, 1882. He reported the thrushes most abundant in the belt of stunted fir and spruce bordering the upper edge of the heavy timber at about 3800 feet; but they extended downward in decreasing numbers to 3000 feet and upward as far as fir and spruce shelter permitted. The reference cited (Brewster, 1883) gives a glowing and extensive account of this trip and its results. Two specimens were collected, and two summers later, July 11–12, 1884, four more birds of this form were secured. Apparently Chadbourne accompanied him on this second trip, for, although no mention is made of that fact, there are four specimens in the Thayer collection taken by Chadbourne at the same

time and place. (Two of Brewster's specimens are in the Boston Society, the other four and Chadbourne's four are at the Museum of Comparative Zoology.) Aside from these ten early specimens no collecting seems to have been done there, nor have there been any definite subsequent reports concerning its occurrence.

Chadbourne's observations (Chadbourne, 1887) merely confirmed those of Brewster. Bicknell's thrushes were "found from an altitude of 3000 feet to the limit of stunted spruces . . . , 4340 feet in Tuckerman's Ravine being the highest point at which it was noted. . . . It was most abundant, however, in the woods opposite the Half-way House and for about a mile below it."

Faxon and Allen (1888) next reported Bicknell's thrush "common on Mt. Lafayette, about the Eagle Lakes." They also heard them on Mt. Cannon.

In 1896 A. B. Van der Wielen collected two males on Carter Dome, the specimens now in the Academy of Natural Sciences, Philadelphia. Later, in 1899, R. H. Howe, Jr., obtained a specimen on Sept. 5, in Carter Notch, and secured a second bird in the same place, June 14, 1902 (Boston Society).

G. M. Allen (1902) summarizes a number of earlier unpublished observations and adds some of his own. He alludes to a nest found on Mt. Moosilauke by Faxon and Brewster on June 22, 1896; and a specimen with these data in the Museum of Comparative Zoology bears the inscription, "parent of nest and eggs A/3." "South of the main ranges," he says, "it doubtless breeds in small numbers on the Sandwich range, where Mr. F. H. Allen has found birds in late June on Tripyramid (4184 feet) and Black Mountain (3900 feet) as well as on Osceola and Tecumseh (both over 4000 feet) and also heard them singing June 7, 1900, near the top of Mt. Chocorua (3508 feet)." G. M. Allen adds records of his own for Moat Mountain, in July and September, and contributes some interesting observations made on the Carter Mountains.

In 1904, F. B. Spaulding ascended Mt. Madison with the intention of finding the nest and eggs of this form, and descended triumphantly in possession of a set of four. The following year he and John Lewis Childs tried their luck on Mt. Adams, another of the Presidential Mountains, and were again rewarded by finding an empty but freshly built nest zealously guarded by thrushes. Ten days later Spaulding returned and collected the nest with three eggs. Accounts of these conquests were published in succeeding numbers of *The Warbler*, of which Childs was

editor, a photograph of the nest and eggs in situ serving as frontispiece on one number and a colored plate of the eggs illustrating another (Spaulding, 1905; Childs, 1905, 1906).

A specimen at Cambridge, taken on Mt. Madison, June 25, 1908, by McKechnie bears the note: "Breeding — shot at the nest."

During the summer of 1912 Alice Corey (1913) found them on Mt. Pemigewasset at 3300 feet, and the following year, on June 29, heard six singing at Lonesome Lake, 2800 feet (on top of one of the spurs of Mt. Cannon).

Mathews (1921) intimates that some of his material on the song of Bicknell's thrush was obtained at Lonesome Lake and that he was familiar with their songs about Mt. Cannon and Mt. Lafayette.

Bagg (1923) reported that "Moosilauke is famous for its nesting haunts of Bicknell's Thrush," probably on the basis of the one nest observed there by Faxon and Brewster.

The records kept by the Biological Survey contain the brief additional, but rather indefinite, items. "N. H. Mt. Washington, Lake of Cloud, June 14 - Sept. 10, 1930, E. G. Loomis Jr." and "N. H. Canadian Lakes = (Connecticut Lakes?) nest."

Gillet (1935) mentions listening to a Bicknell's "singing . . . the night in," just under the boulder top of Mt. Monadnock. I believe he was also familiar with these birds in the vicinity of Lafayette and Cannon.

Dr. Gross (in a letter) writes that they are common in the vicinity of Lost River where he has frequently seen and heard them during his two summers at the New Hampshire Nature School. On July 14, 1933, he found a nest with four eggs.

In view of the multitude of tourists and hikers penetrating the White Mountains every summer, not a few of whom are more or less bird-minded, there are doubtless many unrecorded observations of these birds in their summer haunts. These mentioned, however, are the only ones that have come to my attention.

### *Vermont*

The Green Mountains of Vermont, though not comparable with the White Mountains in either altitude or popularity among tourists, are actually far more extensive. In fact, the mountainous area of this small state is said to exceed the combined areas of the Catskills, Adirondacks and White Mountains; and there is a current belief, perhaps not adequately verified, that if Vermont were flattened out its area would equal

that of Texas. Unlike its neighboring states, whose peaks are more scattered and isolated, the Green Mountains form a continuous chain from Massachusetts to Canada, with many lateral ridges added to the central one. There are more than four hundred peaks with an elevation of 2000 feet or more, over thirty of which exceed 3500 feet.

This extensive mountainous area, with the majority of its peaks wooded over the top, would seem to provide optimum breeding conditions for Bicknell's thrush. This suggests a probability — which as yet has no observational basis — that this bird reaches its center of abundance in the Green Mountains. Certainly more than thirty, and probably more than fifty, of its peaks provide suitable conditions for its breeding requirements. But with the notable exception of Mt. Mansfield, which alone has an auto road to the summit, very few of the peaks have been ascended with the purposive view of investigating avifauna. Consequently the thrushes are known to summer on only a few of the better known or more accessible mountains.

Mt. Mansfield (4393 feet), in the north central part of the state, and in the very heart of the most mountainous region, provides a disproportional share of records for Bicknell's thrush. Torrey (1889) first noted them there in 1885 when he spent four days on the summit. He reported them both abundant and tame; but subsequent observers have never been able to verify this tameness, nor, for the most part, their abundance.

Except for a young bird in the flesh which was sent to Torrey from Mansfield after his visit there in 1885, the first specimens seem to have been taken by Batchelder, who secured two females on the mountain in 1895. (Unpublished records).

A. H. Howell, in particular, has contributed much to our information on Mt. Mansfield thrushes. In 1899, 1900, and again in 1933, on the latter occasion in company with Thomas D. Burleigh, he spent considerable time at the summit observing birds. Six specimens were collected, five now at Washington in the Survey collection, the remaining one supposedly in the Brooklyn Museum, though not found among other specimens of this form when the writer was there. In addition to securing the five skins, which admirably illustrate both intermediates and extremes of the interesting case of dichromatic plumages in these thrushes, Howell has contributed some good field observations, although he found the birds very wary and next to impossible to study.

Mrs. Davenport (1903) reported the thrushes "abundant on the whole mountain crest wherever the swampy ground supported a growth of

dwarfed spruce and fir." She also has added other interesting observations on these summit-dwellers.

Hoffman (1904) gives a short account of this form in his bird book, evidently based on his own observations on Mt. Mansfield.

Helen Whittle (1920) furnishes a charming little article on her experiences with Mt. Mansfield thrushes, giving particular attention to Bicknell's.

Mathews (1921) records two songs of this form by use of notations on a musical scale, the songs apparently taken down as heard on Mansfield.

It has also been observed here by Dr. and Mrs. Lucretius Ross (1924), Eaton and Curry (1926), G. H. Ross (letters), and J. L. Peters (letters).

Mr. Gillet tells me that the birds seemed to him much more abundant on Mt. Mansfield than in the Catskills, the White Mountains, or the Canadian Labrador.

Bicknell's thrushes on Mt. Mansfield have no doubt been noted by many other observers, since the Summit House furnishes such comfortable quarters for summer tourists and vacationists, some of whom remain throughout the season. The above, however, seems to present the extent of the published records.

Probably Mt. Killington rates next to Mt. Mansfield in number of reliable observations on the form in question. This peak, situated in the southwestern part of the state, was included by Ridgway (1907) in his designation of the Bicknell's range, citing Howe as the authority for the inclusion. Howe (1902) merely lists Killington among a number of the other localities without any substantiating evidence, but probably his statement was based on the verbal testimony of Mr. G. H. Ross, who has frequently observed them there. The latter writes in a letter that they occur lower than 3000 feet along the trails to Killington. Specimens were taken on Killington by him and Sheldon in 1915, but they are no longer extant. G. L. Kirk has a specimen taken there, June 25, 1916, and Duane Kent of Rutland has two sets of eggs from the same place, taken in 1922. F. H. Allen (1908) noted eight singing around the summit about June 21, but a week later only one or two were heard. J. L. Peters has two Killington specimens. This form has been observed on the peak also by Dr. and Mrs. Lucretious Ross (1924), and Eaton and Curry (1926).

Couching Lion, colloquially known as Camel's Hump, is also a favorite haunt of these thrushes, but it has received almost no published attention. The last two references cited above mention the bird's presence on this peak, and G. H. Ross and J. L. Peters tell me that they have

observed it there. In the summer of 1933, a section of the Vermont Bird Club took a census of the birds of this region, and on the basis of song reported 18 breeding pairs from the summit of the mountain. My first acquaintance with this fascinating bird was on this mountain, where it seemed to be particularly abundant.

Jay Peak, on the northern border of Vermont close to the Canadian line, was also included in Ridgway's designation of the Bicknell's range. But here again the inclusion was based on Howe's list of localities, which may have had no observational basis. However, there is no reason why they should not occur there. It would be interesting to learn which color phase predominates on that far northern mountain.

An admirable way of studying the little known distribution of Bicknell's thrush in the Green Mountains would be to take a Long Trail trip in June noting its occurrence and relative abundance along the way. This was done by Eaton and Curry (1926), though in various stages. They noted its presence on Mt. Stratton (3859 feet), Mt. Bromley (3260 feet), Mt. Carmel (3341 feet), Mt. Horrid (2850 feet), Mt. Lincoln (4013 feet), Breadloaf Mt. (3823 feet), Mt. Theodore Roosevelt (3580 feet), and Bolton Mountain (3725 feet), in addition to the peaks previously mentioned. The presence of this form on the southern, hardwood-covered peaks as well as the northern, fir-clad ones led them to believe that "the occurrence of this bird is an excellent example of control of habitat by altitude rather than vegetation as Mts. Bromley and Carmel are deciduous whereas the northern peaks are forested with spruce and fir alone on the higher levels." However, the occurrence of these birds at sea-level on certain islands and maritime coasts suggests that altitude alone is not the controlling factor. Perhaps the principal requirement is a general climatic one, or a complicated combination of certain factors, in which temperature, altitude, humidity, and evergreen forests play a significant role.

The bird is known to occur on Pico Peak, where G. H. Ross and Sheldon took specimens in 1888. Mt. Annanance (*i.e.* Willoughby) was also on Howe's list.

My own observations are limited to the vicinity of Mt. Mansfield, on most of whose neighboring mountains this form has been observed. Singing birds proved to be abundant on Bolton Mountain in early June, just before the retreat of the last snow. In July (1935) three nests on Mt. Admiral Dewey were located in a very short time, although but few birds were seen, as they are very retiring in midsummer. They were not found

on Mt. Admiral Clark or Mt. Admiral Mayo in late summer, but they probably occur there nevertheless. Its presence on Madonna (one of the Sterling Mountain peaks) is verified by both June and September observations. It doubtless also inhabits Whiteface, and Morse Mountain, as well as Belvidere.

Finally, the records kept by the Biological Survey contain eight June records for this form in Vermont, only two of which correspond to those mentioned above. The remainder are chiefly from valley towns, and whether they represent actual specimens (which is doubtful) or sight observations is not clear. The Burlington record may be the specimen now mounted there in the Fleming Museum without data other than the *bicknelli* label, but the specimen is in reality a hermit thrush. The Huntington record, June 26, 1926, probably refers to an observation on Couching Lion. The Waterbury, Woodstock, and Wells River records look rather dubious at best.

### *Massachusetts*

Although for the most part lying south of the range of this form, Massachusetts provides one locality in the Berkshires where a few pairs may occasionally breed. This was first demonstrated by Faxon (1889) in 1888, when he secured on Mt. Greylock (3505 feet), July 6, a specimen which had been in full song for four days and whose testes clearly indicated it to be a breeding bird. Five days of subsequent search for a female and nest, however, proved unavailing, and the male songster may have represented an unmated or post-nesting bird. In 1895, and again in 1896, Faxon visited the summit of Greylock, once more "hearing, both in the evening and morning, the song so admirably characterized by Burroughs in *Riverby*" (Faxon, 1895; Faxon and Hoffman, 1900). Neither year's search, however, disclosed a nest, though the single pair present manifested signs of breeding.

R. H. Howe Jr. (1902) adds a fourth year's record to those of Faxon's, reporting one "calling on the summit of Mt. Greylock on the 18th" (June, 1902).

C. J. Maynard (1910), ascending Greylock somewhat earlier in the season than other observers, May 28–30, reported about a dozen pairs. The following year C. F. Jenney (1911), on June 8 and 9, found several birds (two heard, one seen). This evidence seems to indicate a northward migratory movement in spring along the mountain chain.

The Survey records contain the additional items "Williamston,

June 11, 12 and 18, 1913; and June 11 and 12, 1914. — Brainard." These are presumably Greylock records, but probably not representing specimens.

*New York*

The Adirondacks of New York contain many peaks seemingly suitable for breeding grounds, but the paucity of information from the region indicates that they have been generally neglected.

Although long assumed that Bicknell's thrush breeds in the Adirondacks, this fact was not actually disclosed until the summer of 1905 when E. H. Eaton with a party of observers ascended Mt. Marcy. He writes "Our Adirondack party in 1905 found it fairly common in the vicinity of Mt. Marcy, both on the Geological Cobble, Bartlett ridge, and the slopes of Mt. Marcy, Skylight, Haystack, and various other neighboring peaks up to the limit of tree growth. . . . We found them feeding young on July 12 near Skylight Camp and on July 18 took an adult male in full song near Lake Golden, at an altitude of 2800 feet." (Eaton, 1910).

A lapse of twenty years intervened before further information from the Adirondack region was reported. Then Aretas Saunders spent the summers of 1925 and 1926 in the vicinity, studying both lowland and upland birds. He found Bicknell's thrush "on the higher slopes of both Mt. McIntyre and Mt. Marcy. . . . Dr. Harper collected a juvenile bird at about 3000 ft., July 26, 1925," and Saunders observed an adult "evidently worried about its young, at about 3800 ft., along the Marcy Trail, July 25, 1926." (Saunders, 1929).

Edward Weyl (1927) also reports "A pair of Bicknell's Thrushes was encountered on the Marcy Trail. . . . From their anger and boldness we judged we were near the nest, but a search did not reveal it." On an earlier trip they found one individual on Giant Mountain.

*Catskills*

The belated discovery of Bicknell's thrush in the Catskills in 1881 has been mentioned. While bird-watching near the summit of Slide Mt. (4205 feet), E. P. Bicknell collected two specimens of a thrush which had been singing a song conspicuously different from that of the olive-backs in company with them. A comparison of the skins with other *Hylocichlae*, as mentioned earlier (Ridgway, 1881), resulted in the recognition of a bird new to the country's avifauna. Brewster (1883) has appropriately added that the discovery of this new thrush "can scarcely fail to be

tempered with chagrin that so interesting a stranger has all this time existed among us undetected." Finding this form breeding in the haunts of the olive-back also ended the long controversy on the relationship between the olive-back and gray-cheeked thrushes, the evidence here produced irrevocably acclaiming their specific separateness.

The following summer Bicknell returned to Slide Mt. with A. K. Fisher and reported the thrushes common, judging by the songs heard; but they so effectively concealed themselves in the dense balsam groves that only one could be collected (Bicknell, 1882).

Burroughs (1895) was apparently acquainted with this form, giving a singularly pleasing description of the charming, flute-like song he heard in the Catskills.

The New York State Museum has a specimen from the Catskills, taken August 7, 1897, purchased from Dr. W. C. Braislin.

Records of the stomach examinations made by F. E. L. Beal at Washington include two Bicknell's thrushes collected by J. A. Weber on Slide Mt., June 25, 1909.

Mary Daley (1922) reported seeing and hearing it several times on Slide Mt., evidently nesting.

Gillet (1935) heard a chorus of three or four on Mt. Wittenberg and found a nest on Slide Mt.

### *Pennsylvania*

It is not a matter of surprise that since the Alleghany Mountains possess many features in common with the Catskills, bird watchers began to investigate the Alleghanies expectantly for Bicknell's thrush. Its presence had been verified in all the mountainous states to the northeast and the Alleghanies were the next logical place to look for them.

Thus B. H. Warren in his *Birds of Pennsylvania* published in 1888 stated without any observational basis that it "probably occurred in the mountainous regions of the state as a summer resident." Fortunately no one took the initiative of publishing an actual summer record until 1904 when Carter observed a small thrush, which he believed to be Bicknell's, on Pocono Plateau, a sort of southern extension of the Catskills in Pennsylvania. The bird possessed a "peculiar, spiral, veery-like song, faint yet penetrating," which is a fitting description of the true Bicknell's refrain. He found it in company with Canadian avifauna such as winter wrens, red-breasted nuthatches and golden-crowned kinglets, which are the breeding companions of Bicknell's thrush in the mountains

of New England. The following summer Weygandt, who believed himself familiar with the songs of all thrushes in Pennsylvania, saw and heard a new thrush at Broadheads Creek, Monroe County, which he assumed must be a Bicknell's, and reported it on the basis of Carter's and Bailey's earlier records (apparently Bailey must have reported it verbally in a meeting of the Delaware Valley Ornithological Club.)

A few years later, Carter chanced to spend his summer vacation in the White Mountains of New Hampshire where he had ample opportunity to become acquainted with the songs of both Bicknell's thrush and the olive-back. And to his credit it may be added that in a December meeting of the Delaware Valley Ornithological Club he acknowledged both verbally and (later) in print that the supposed Bicknell's thrush observed at Ponoco Lake was unquestionably an olive-back, (an acknowledgment which Brewster neglected to make when he published a description of a supposed Bicknell's song which later proved to be that of an olive-back).

Though similar confessions have not come, so far as I know, from the other two observers of Bicknell's thrush in the Alleghanies there seems little doubt regarding their improbability.

### *North Carolina*

The wildest of possible breeding records comes from Black Mountain in North Carolina. Cairns (1889) reports shooting a specimen there in August, 1885 or 1886, but he was not sure of the date. The bird was listed with typical upper Canadian avifauna such as brown creepers, red-breasted nuthatches, golden-crowned kinglets, etc., breeding at 5000 feet; but Cairns did not necessarily imply that the thrush was breeding there.

Last spring I chanced to run across what is probably the specimen on which this curious record is based, a specimen at Cambridge collected by Cairns in Buncombe County, North Carolina, and dated July 16, 1886. It has a wing length of 100 mm. and is therefore a gray-cheek rather than a Bicknell's; but the brownish dorsal coloration suggests it may be the Newfoundland form. Such a summer record is difficult to explain, unless we assume a mistake in the date.

### *Summary of Breeding Distribution*

Bicknell's thrush, comprising two color phases, breeds in the Gulf of St. Lawrence region (North Shore, Gaspé, Magdalen Islands); Nova

Scotia (Seal Island, West Cape, Mud Islands); Maine (Mts. Katahdin, Bigelow, Abraham); in practically all of the White Mountains, Green Mountains, and probably the Adirondacks above 3000 feet; the Berkshires (Greylock); and the Catskills (Slide Mt., Mt. Wittenberg). No other authentic localities have been noted.

## Migration Records

Thrushes may be found in their mountainous haunts as late as September 20 (Sweet, 1906), but between the 20th and 30th of that month they appear in southern New England in considerable numbers. In spring they have been found returning to the mountains between the 25th and 30th of May; and spring migration records from southern New England support these observations, although belated migrants may linger into early June.

In keeping with their generally observed traits, the migrants are usually shy and retiring, feeding quietly and for the most part undetected in shady lanes, along well-vegetated beaches, and in denser woodlots, occasionally emerging into more open orchards and gardens. In spring they sometimes burst into brief snatches of song. In fall they take considerable quantities of wild fruit, such as dogwood berries, but probably never neglect for long their habitual animal diet. The autumn migration in particular is leisurely, the migrants often lingering for several days in the same place, and consuming nearly a month in journeying from New England to the southern states. The vernal movements are somewhat more hurried but may doubtless be temporarily halted due to inclement weather, especially along the southern limits of the breeding range since their completely snowbound summer haunts may force a delay, even in late May.

Migration records from southern New England are chiefly from on or near the coast, some of them probably due to Nova Scotian and St. Lawrence birds moving leisurely along the shores. But the presence of numerous brown-phase birds among the migrants suggests that those from mountains to the north may also emerge upon the coast. Interior records for Massachusetts and Connecticut are quite rare, perhaps because more collecting has been done in the Cambridge and New Haven areas. There is some evidence that the thrushes make use of mountain ridges wherever possible in passing to and from their breeding grounds, in which case Vermont birds might be expected to migrate through the Berkshires of Massachusetts. This expectation is supported by observa-

tions, for the birds are more numerous about Greylock and southern Vermont mountains during migration than during the nesting season (Maynard, 1910); and also by the paucity or complete lack of records in the valleys where these ridges occur. The Hudson River may serve as a migratory highway for Adirondack and Catskill birds, — in fact E. P. Bicknell collected several migrants near his Riverdale home. They emerge in considerable numbers in New York Harbor, presumably converging there from all northern points during fall migration. Merriam's Lewis County specimen suggests that the migrants occasionally wander from the beaten path.

The list of locality records (page 395) is a trustworthy index of the time and extent of the migration of this form through southern New England.

### *Maine*

Only three specimen records were found for this state, and of these the measurements for two look a little questionable. The third record (Norton, 1909), a specimen in the Portland Society of Natural History, has not been examined.

### *Massachusetts*

There are 19 indubitable records among the specimens examined from this state, and there are additional specimen records not examined. The majority of them are from the Cambridge region.

### *Rhode Island*

Howe and Sturtevant (1899) report a specimen taken at Warwick, now in the Smith collection. In spite of the paucity of evidence, however, Bicknell's thrush must migrate regularly through a section of the state, to explain the Cambridge specimens.

### *Connecticut*

The Bishop collection in New Haven contains 16 verified specimen records from that vicinity, to which may be added some nine skins in other institutions. Only three of the latter were examined, however.

### *New York Harbor and Long Island*

New York Harbor and adjacent parts of Long Island have yielded particularly rich returns of migrants that seem to congregate there.

Foster collected three at the Statue of Liberty. Fire Island Light in the Harbor, and Shinnecock Light on Long Island have taken a fairly heavy toll of birds passing at night. The list of records enumerates 23 specimens examined and about 13 others not available for examination.

### *New Jersey*

From lower New York regions migrating Bicknell's can be traced along the coast, in steadily decreasing numbers, but are rarely taken very far inland. W. E. D. Scott more than any one else has exposed the status of this bird in New Jersey. His unpublished specimen records are widely scattered, however, ten positive specimens having been found in five different institutions, as well as four additional uncertain ones of rather intermediate birds. Mr. C. H. Rogers has kindly measured the Princeton birds for me. Scott's specimens were taken in South Orange and Princeton. The only other records found for the state are Rogers' Princeton specimen and the two birds in the American Museum, one from Barnegat and one from (West?) Orange.

### *Pennsylvania*

There are in the literature some ten to a dozen records from eastern Pennsylvania, mostly from the Philadelphia region; but none of the specimens have been examined. Dr. Stone has sent me the data on the five Pennsylvania skins in the Academy of Natural Sciences, only one of which corresponds to the records mentioned in the literature. The specimen taken by Collins at Frankfort, Philadelphia, October 16, 1878 is doubtless the S. N. Rhoads specimen bearing the same data in the Academy collection. Though Collins is reported to have taken several others at about the same time (Stone, 1894), they apparently are not in the Academy collection. Both Stone (1894) and Burns (1919) mention the Josiah Hoope specimen taken at West Chester in 1893, and Burns adds another county record from Berwyn, October 6, 1915, taken in his orchard while feeding on pokeberries. Professor J. H. Roddy collected a specimen near Chickies Rock, Lancaster County (Warren, 1890), but was not sure of its exact identity though he believed it to be a Bicknell's. The ultimate disposal of these specimens has not come to light.

### *Maryland*

Two specimens taken by Ridgway at Laurel, now in the National Museum, are typical representatives of the smaller form; but the third

specimen supposed to have been taken by him in the same place (May T. Cooke, 1929) is not with the others. Jenning's two specimens taken at Baltimore, which are also in the National Museum, have been reidentified as gray-cheeks, one of which is the Newfoundland form. Wing lengths are 102 mm. and 104 mm., far above the maximum for Bicknell's. thrush.

### *District of Columbia*

Bicknell's thrush appears to be a regular migrant through the region about Washington, D. C., as indicated by the Laurel specimens. There are quite a number of records from Washington itself, only three of which I have been able to verify. The Howell specimen in the Biological Survey, and one of the Richmond specimens in the National Museum are certainly authentic records; and the A. K. Fisher specimen at Cambridge, though inclining toward intermediacy, probably should be assigned to the smaller form. The other Washington records, three by C. W. Richmond, two by E. A. Preble, and one by W. W. Cooke (M. T. Cooke, 1921 and 1929; Maynard, 1902) have either been reidentified or else the specimens have not been found. Some may have been sight records only. Palmer took a typical specimen at Rock Creek, and Riley one at Falls Church, Virginia, close by.

### *Virginia*

Other records from Virginia are two birds in the American Museum from Dismal Swamp, and a dubious intermediate from Campbell County.*

### *North Carolina*

Bicknell's thrush has been taken occasionally in this state, chiefly by the Brimley brothers at Raleigh (Brimley, 1890, 1917; Pearson, Brimley, and Brimley, 1919). The specimens, obtained nearly 50 years ago while the Brimleys were doing commercial collecting, are somewhat scattered now, but H. H. Brimley has kindly sent me a list of all the records they have handled, including specimen measurements. In "Birds of North Carolina" the authors summarize the situation: "Occurs at Raleigh sparingly, having been taken from May 3–18 in spring and September 24

* William J. Rusling (Auk. 54, 1937, p. 395) adds with data a new Virginian record of a dead bird found by him at Kiptopeke, October 3, 1936.

to October 12 in fall." The spring data are based on four authentic records, but the three fall specimens by measurement are actually the larger form.

At Weaverville, in the western tip of the state among the southern Alleghanies, Cairns reports this form from September 11 to November 10; but there seem to be no specimens bearing those dates. However, he has taken it on September 22, 27, and October 28. The appearance of this form in the southern tip of the Alleghany Mountains is somewhat surprising, since none have been reported northward in the Appalachians.

Miss Mabel Shields of the Fairbanks Museum, St. Johnsbury, Vermont, writes that they have two mounted specimens originally from North Carolina without any further data.

Mr. Thomas D. Burleigh writes in a letter: "During the five years I carried on field work in North Carolina, I never succeeded in taking a single specimen of this race of the Gray-cheeked Thrush. During each spring and fall migration Gray-cheeked Thrushes were collected to determine the occurrence of *minima* in this region, but invariably without a single specimen being taken."

It seems possible that somewhere in the North Carolina region part of the migrants of this form may leave the continent for their West Indian winter home, thus shortening their migration route. This would help explain the scarcity of migrants which collectors in the southern states feel actually prevails there. However, it is a long cross-water hop for a thrush from North Carolina to the Bahamas en route to more southern islands, and some of them at least continue to wander down the coast to Florida before attempting the overseas flight.

### *South Carolina*

A few specimens have been taken in the vicinity of Charleston, South Carolina, but of the three specimens taken there by Wayne and Brewster in 1885, now at Cambridge, only one is a positive record, a second bird being near the border-line in favor of *bicknelli*, and the third unquestionably a gray-cheek. Another specimen taken by Wayne at Mt. Pleasant (near Charleston) is also supposed to be in the Brewster collection (Wayne, 1910), but I did not find it either at Harvard or in the Boston Society, between which places Brewster's collection appears to be divided. Wayne considered this thrush rare in South Carolina.

Loomis (1887, 1891) collected two specimens of the smaller form at

Chester, both now at the American Museum. The former was "shot May 6, 1887, in an undergrowth of timber near Chester."

*Georgia*

Records from northern Georgia contribute additional indication of what has already been suggested in the Carolinas: there appears to be a western branch of migrants emerging at the southern end of the Appalachians which keeps well to the west of the coastal region over an inland route destined to take them toward the Gulf.

All the personally verified specimen records from this state are from the interior. Hembree has been an ardent collector in the vicinity of Roswell (near Atlanta), and although some of his specimens are incorrectly identified, four of them at least appear to be authentic. One of Kennard's Roswell specimens and three others in Bishop's collection are the smaller form. Another Hembree bird in the Bishop collection is near the borderline, but on the gray-cheek side.

Burleigh collected a fall male at Athens with a wing length of 94.5, a specimen now in the Biological Survey.

Other inland records not personally verified include an Atlanta specimen found dead by E. R. Greene and identified by A. H. Howell; a bird from Fulton County (probably Roswell) reported by Greene (1934) as being collected 18 miles north of Atlanta by Hembree and identified by Oberholser; and an injured thrush captured on Mt. Enota and measured and identified as the smaller form (Greene, 1934).

The only coastal record I have been able to find is one reported by Wayne (1918), of a specimen collected by Perry at Savannah, May 16, 1910, which for a long time was erroneously labeled an olive-back.

*Florida*

A few records from the east coast of Florida, however, indicate that Bicknell's thrush must migrate along the Georgia coast in spite of the lack of confirmatory records. In the Peabody Museum at Yale is a specimen (not examined) from Amelia Island (Nassau County) close to the Georgia line. The Field Museum also has a specimen from Nassau County (wing 94 mm.) which is very probably the smaller form. A third specimen from Eau Gallie in Brevard County, one of Worthington's birds, now in the Museum of Zoology at Ann Arbor, is hard to identify with certainty since the wing tips are badly frayed. But by comparing the unfrayed primaries with corresponding primaries of other specimens

of both forms there seems little question but what the bird is a Bicknell's thrush whose wings with restored tips would probably not exceed 94 mm. It is recorded as a male, and is intermediate in respect to color phase.

There seem to be no reliable records from the west coast of Florida. The specimen from Key West in the Field Museum is really a gray-cheek. Apparently Hellmayr, in working up the last volume of his *Birds of the Americas*, agreed with the identification of the *minimus* type at Harvard, which probably accounts for the erroneous identification of some of the Field Museum specimens of the gray-cheeked group.

H. H. Bailey (1925) in his *Birds of Florida* wrote of Bicknell's thrush, "rarest of the Thrush family to visit Florida in migration, . . . during November; and again in late April and May." However, he gave no records, and since there seem to be no published records from the state the inclusion seems untrustworthy. A. H. Howell (1932) in his *Florida Bird Life* did not include the smaller form.

### *The Bahamas*

The one record from the Bahamas substantiates the logical postulation that these thrushes migrate to and from their winter home in San Domingo by traveling along the Bahamian chain of islands. Cory (1891) reports a specimen collected on Cay Sal by Cyrus Winch, sometime between May 14 and 19, 1891. Cay Sal is a fertile island 60 miles north of Cuba with an interior pond surrounded by coconut and other trees. At the time the specimen in question was collected the island was swarming with north-bound migrants of many species.

Thus it seems that both the migrants that take off from the continent in the Carolinas, — if any do, — as well as those continuing along the coast to Florida, must find it convenient to reach their winter home by migrating along the chain of numerous islands stretching between Florida and Haiti.

### *Alabama*

The interior route is harder to trace. That the Georgian migrants appearing in the vicinity of Atlanta continue into Alabama is indicated by specimens obtained at Greensboro by Dr. Avery. Recent examination of these skins, however, discloses the fact that only two of the original five are definitely the smaller form. (Holt, 1921).

### *Louisiana*

In the National Museum at Washington is an unsexed specimen with a wing of 95 mm. taken at New Orleans. If the bird were a male it would unquestionably be a Bicknell's thrush and if a female it might be. It is a gray-phase bird.

Arthur (1918) in his *Birds of Louisiana* reports: "I collected this subspecies from among a number on Breton Island, May 16, 1907. They were evidently leisurely migrating northward."

The assumption that Bicknell's thrush has an alternative inland route emerging at the mouth of the Mississippi and crossing the Gulf rests on this rather unsubstantial evidence of two records, the one examined known to be uncertain. (The Ariel, Mississippi, specimen of Bicknell's thrush in the National Museum is wrongly identified.)

### *Central America*

If migrants actually cross the Gulf one might expect to find them in Central American collections, if such were adequate. In the British Museum are two unsexed specimens of this species, one from Cozumel Island off the east coast of Yucatan, taken April 30, 1885, and one from Ruatan Island in the Bay of Honduras taken sometime in 1886. They have wing measurements of 96 and 95 mm. respectively. If they are males they should be examples of Bicknell's thrush, and if females one of them might be. These two specimens, together with another, larger-winged Ruatan bird, apparently were the basis of the commonly accepted statement that *aliciae* migrates around the eastern islands of the Central American coast on the way to South America. It now appears that some of the smaller form may likewise possibly use this route.

### *An Alternative Great Lakes-Mississippi Route*

The frequent occurrence of records from mid-western states, especially the Great Lakes region, has repeatedly suggested that Bicknell's thrush, although confined to eastern regions in the breeding season, must wander westward occasionally during fall migration, possibly migrating southward by the Mississippi valley route. It may be well to consider this possible interior route.

There are no less than eighteen instances of the supposed occurrence of the smaller form in interior regions, practically all of which have appeared as published records. An examination of collections from these

regions discloses many other specimens either questioningly identified as *minima* or at least conforming to the same size standards. Ridgway early extended the known range of this thrush to Illinois on the basis of one of C. K. Worthen's specimens taken at Warsaw (on the Mississippi), May 24, 1884, and numerous subsequent records have tended to verify this unexpected occurrence.

Examination of some of these specimens, however, quickly brought to light the puzzling fact that, though admittedly within the measurements established for Bicknell's thrush, practically all of them were close to the maximum and no typical or irrefutable specimen has yet been examined from the Great Lakes states. By lowering the minimum wing measurements previously used for the larger form two millimeters in the case of the females and one millimeter for males, an act which is now authorized by measurements of one hundred and thirty-eight *breeding* adults of this species, many of the dubious midwestern records can be reidentified as gray-cheeks. The few remaining records, if authentic, can best be explained as stragglers or accidental records rather than regular migrants. It may be well, however, to analyze some of these curious and interesting records.

### *Saskatchewan*

The most unusual record of the western occurrence of the smaller form is of a spring migrant collected by Bishop at Maple Creek, Saskatchewan, June 8, 1906. Two females were taken "in the great wave of migrating birds that swarmed through Maple Creek timber" among which thrushes proved to be very numerous (Bent, 1908). One was a typical female northern gray-cheek with a wing of 99 mm. (measured by Peters); the other, a female now in the Bishop collection, has wing measurements of 91 and 92 mm. Though nearly as gray as breeding Alaskan gray-cheeks in color, suggesting both by its color and the peculiar locality that it is a dwarfed specimen of the larger race, nevertheless, according to measurements it certainly fits only the smaller form. The tail and tarsal measurements are likewise typically "bicknellian" in character. It seems best therefore to consider this as an accidental record of Bicknell's thrush. Other species, more easily identified, have frequently been taken farther out of their habitual course than this.

Apparently this record, perhaps strengthened by other records that have not come to my attention, has been the basis of a belief on the part of some ornithologists that the so-called Bicknell's thrush actually occurs

as a breeding bird along the whole southern periphery of the larger gray-cheek's range. Since no breeding birds of the smaller form have actually been taken, and since only one exception has been found among many migrants, there seems to be no trustworthy ground for this belief.

*Ontario*

Ontario has been a puzzling region in respect to these thrushes. The occurrence in migration of so many intermediate birds has forcibly suggested that the two size forms may come together and intergrade somewhere in southern Quebec. The avifauna of the regions under consideration, however, has been carefully studied by Taverner, Fleming, Lewis, Dwight, and other ornithologists; and to all appearances *bicknelli* is confined to the extreme eastern coasts and islands of the St. Lawrence region, not entering the wide mouth of the river even as far as Tadousac, where Dwight spent several summers. In fact it is not known west of the Gaspé peninsula. Moreover, the larger race does not occur even as far south as the southern shores of Hudson's Bay, and consequently in the regions where these birds might be expected to intergrade, to explain the Ontario intermediates, both races are completely lacking. Some other explanation must be sought for the middle-sized migrants.

The questionable status of the smaller form in Ontario was introduced and perpetuated by Ridgway who wrote on the labels of two Hamilton birds submitted to him for identification, "intermediate, but near bicknelli." A third bird from Toronto was similarly identified (Fleming, 1907). The Hamilton birds have been examined on two occasions, once in a loan of specimens from Fleming's collection, and once at his home. Both are spring males with wing measurements of 97, and strangely enough, both appear to be of the brown phase, although both size forms of this type of coloration are restricted to the east in summer. If correctly sexed, then, these birds are *bicknelli* in both color and size, and as spring migrants they may have been headed eastward across Lake Ontario to the Adirondacks, their nearest breeding grounds. However, with 97 mm. as the extreme maximum for *bicknelli*, and 98 mm. the minimum for males of the larger form, there can be no conclusive identification of these birds.

Regarding two other specimens, one from Toronto (probably the one referred to in the preceding paragraph), and one from Exeter, Fleming writes in a letter the following entry from his journal: "Ridgway says of these two skins that they are both in size and color with *H. a. bicknelli*."

Saunders (1905) reports a specimen taken at Bryanston by Robert Elliott, September 16, 1898, and identified by R. H. Howe, Jr. This specimen, now in W. E. Saunders' collection, has not been examined, but since Howe's reputation for identifying birds has sometimes been questioned, perhaps the record cannot be considered wholly trustworthy.

An examination of the birds in the Royal Ontario Museum of Zoology at Toronto reveals additional puzzling specimens. Two birds from Long Point, a female with a 92 mm. wing and a male with its wings 94 and 95 mm., certainly seem referable to the smaller form. Moreover, there is a slight color difference between the olive phase of *bicknelli* migrants and typical northern gray-cheeks, and the Long Point birds more closely resemble the former; but the color differences are so slight that they are not dependable alone. Another female from Long Point with a wing of 95 (the overlapping range) also falls closer to *bicknelli* in color. Two other females, each with wings of 96 mm., were closer to a true gray-cheek in both color and measurements.

Thus we may conclude that though Bicknell's thrush may and probably does occasionally penetrate Ontario in migration in both spring and fall, specimen substantiation of this belief is hardly adequate.

### *Michigan*

Of the twenty specimens of gray-cheeked thrush from Michigan localities that are in the Museum of Zoology at Ann Arbor, only two approach the legitimate measurements of the smaller form. One, taken at Portage Lake, Washtenaw Co., and sexed as a male, is within the measurements of Bicknell's, and the other, from Tobins Harbor, Isle Royale, Keweenaw Co., also sexed as a male, has one wing on each side of the dividing line. However, such an identification is possible only in case the birds are correctly sexed as males. If they are wrongly sexed, as Dr. Van Tyne thinks is not unlikely, there is no question as to their identity as northern gray-cheeks, a conclusion that seems more probable than that they are actual records of the smaller form in Michigan.

### *Ohio*

Ohio's single record, that of a specimen taken near Toledo by Louis Campbell (1934) in the fall of 1933 and identified by Oberholser, has not been available for checking with my new standard of measurements.*

* This specimen was examined later and found to be an unquestionably authentic record.

*Indiana*

Indiana's single published record (Ford, Sanborn, and Coursen, 1934) on examination proved to be an olive-backed thrush, erroneously identified as a Bicknell's. In the National Museum, however, is a short-winged female (93 and 94 mm.) that is wholly within the range of the smaller form. The primaries seem unduly shortened, though apparently entire, and it may therefore represent an aberrant, short-winged gray-cheek. Otherwise, this specimen must be at least tentatively considered as a Bicknell's thrush, constituting one record for the state of Indiana. It is the olive phase.

*Illinois*

As already mentioned the range of Bicknell's thrush was extended to Illinois when Ridgway identified one of Worthen's specimens as the smaller form. This particular specimen appears to be lost, but it may be the one John Lewis Childs had in his collection at Floral Park, New York (Childs, 1906), since he mentioned having one specimen, an Illinois male, taken in May. (The original specimen was taken May 24, 1884.) Later, Worthen collected other specimens in the vicinity of Warsaw, two of them in the Fleming collection at Toronto, and several others at Cambridge. The two females in the Fleming collection, if correctly sexed, are gray-cheeks; but two of the Cambridge birds fall within the measurement limits of *bicknelli*, though both bear Ridgway's inscription "nearer true *aliciae*." One, a female, has wings 93 and 95 mm.; the other, a male, is 97 mm. A mounted specimen at Cambridge, also from Warsaw, is labeled as a Bicknell's thrush in spite of the fact that its wings are 102 and 103 mm. in length.

At Highland Park H. K. Coale has taken a number of specimens that have a rather complicated history. One of them, a female in the Museum of Zoology at Ann Arbor, Michigan, has repeatedly been identified as a Bicknell's, but although very small and trim in appearance, its wing is 99 mm., which is above the average for females of the larger form. Another specimen, however, in Brodkorb's private collection, has a wing of 95 and is sexed as a male. If correctly sexed, which is not certain, it should certainly be classed as the smaller form. It is rather intermediate in color, inclining toward the brown phase. Still another of Coale's birds taken in Cook County, and now in the Museum of Comparative Zoology, has a wing of only 92 mm., thus furnishing one seemingly probable record for Illinois, to which the several dubious ones may be added.

There are in the collection of the Academy of Sciences at Chicago five specimens which have been referred to the smaller form. Two of them have already been mentioned as brown-phased birds assignable to the Newfoundland type if they are correctly sexed. The other three, unsexed, are probably simply northern gray-cheeks.

### *Missouri*

The view that Bicknell's thrush migrates down the Mississippi valley route seemed to lack only a confirmatory record from some midway station between the Great Lakes and Louisiana. Then came Rudolph Bennitt's timely "Check-list of the Birds of Missouri" with a specimen found by Widmann and Pough in St. Louis, (together with a more dubious record of a bird banded and released in Webster Groves). However, a subsequent letter from Mr. Bennitt explained some very interesting complications regarding this bird. During the preparation of his check-list, he had been unable to locate the specimen anywhere, either through Widmann and Pough who originally found the specimen, or through Dr. Terry who had personally identified the bird by comparison with specimens of Bicknell's thrush in Chicago. Consequently Bennitt accepted the record for his check-list. Later, quite by accident, the specimen turned up in a taxidermy shop in St. Louis, and the owner, Mr. Schwarz, kindly gave Bennitt the specimen for the University of Missouri. Last spring (1935) Dr. Oberholser looked up the specimen and found it to be a gray-cheeked thrush rather than a Bicknell's. From a previous paragraph it may be seen that if Dr. Terry compared the bird with the supposed Bicknell's in the Chicago Academy of Sciences he was probably actually comparing it with gray-cheeks, instead of Bicknell's as he supposed. Such may also have been the case if he used for comparison specimens in the Field Museum.

Thus there appear to be no specimen records connecting the Great Lakes and Louisiana migrants, and as already noted the evidence for migrants in the latter two places is far from satisfactory. Consequently it seems best to regard all interior records of the smaller form as mere stragglers or accidental occurrences. Louisiana birds, however, may be explained as those using the Alabama-Georgia route. The Mississippi River delta, extending some distance out into the Gulf, provides the shortest overseas flight to Yucatan, a path of migration possibly used by these birds.

## Winter Distribution

The location of the winter home of Bicknell's thrush has long been hidden in an obscurity which has even yet been only partially dispelled. Elliot Coues in the 2nd, 3rd, 4th, and 5th editions of his *Key to North American Birds* wrote ". . . migrating south in winter to parts unknown." Stone (1894) in his *Birds of Eastern Pennsylvania* gave their winter distribution as Mexico, on what evidence is not known. The *A. O. U. Check-list* for 1886 and 1895 simply stated "migrating south in winter." The succeeding edition, for 1910, however, added "winter in Haiti and probably northern South America," though I have not been able to find the basis for either inclusion. The final Check-list for 1931 gave Haiti and Venezuela as the wintering grounds, although the type locality is Colombia.

### *The West Indies*

Not until 1921, when Swales and Richmond examined some old specimens of gray-cheeks from the Island of Haiti and found them to be Bicknell's thrush, did the true winter home of this form come to light. Even then this fact evidently was not published till 1931 when Wetmore and Swales' *Birds of Haiti and the Dominican Republic* made its appearance. This important publication seems to be sole authority for the winter distribution of this form. All West Indian records had previously been identified as gray-cheeks.

The Island of Haiti comprises the Haitian and Dominican Republics, of which the latter is considerably the larger. From this island come all the authentic records of winter specimens of Bicknell's thrush, — one from Haiti and probably six from San Domingo. Perhaps they also inhabit suitable locations on other of the West Indian Islands, such as the mountains of eastern Cuba, Jamaica, and Porto Rico; but no specimens have been taken to substantiate this assumption. It may be that the island-breeding birds of the Canadian maritime provinces, such as Seal Island, winter on some of the innumerable small West Indian islands.

The first specimens were taken near Puerto Plata on the north shore of San Domingo by Cory, who secured a female on December 14, a male on December 16, 1882, and a second female January 8, 1883. All were labeled *aliciae* and remained thus for nearly twenty years, when Swales and Richmond borrowed and re-identified the two taken in December. These specimens, belonging to the Field Museum, are typical examples of the brown phase of Bicknell's thrush, the wings of the male measuring

94 and 95 mm., and those of the female 92 mm. The third specimen, taken January 8, is not in the Field Museum collection; but N. B. Kinnear's list of the gray-cheeks in the British Museum includes a female from Puerto Plata, taken January 8, 1883, which undoubtedly is Cory's other specimen. In regard to its identification Wetmore and Swales (1931) noted that Cory recorded its wing as 3.80 inches (equivalent to 96.5 mm.) and concluded on that basis that it was probably a Bicknell's thrush. According to the new measurements this would not be true; but possibly Cory gave an exaggerated wing length (since Kinnear obtained 94 mm. for the same specimen), in which case it is in all probability really the smaller form. Cory gave 3.75 inches (equivalent to 95.3 mm.) for the other female, whereas I obtained 92 mm.; and 3.78 inches (equivalent to 96.0 mm.) for the male, for which I obtained 94 and 95.

In 1895 Cherrie collected two males at Aguacate, San Domingo, one on February 22, the other February 25. These were likewise recorded as *aliciae* until re-examined in 1921 by Swales and Richmond, who then designated them as the smaller form. The one taken February 25 unquestionably is (wings 91 and 92 mm.); but the other specimen (wings 97 and 98 mm.) is on the dividing line between the two size forms. In view of the fact that the larger form has not been, and probably will not be, found wintering in the West Indies, it is safer to consider the specimen a Bicknell's thrush. There is undoubtedly some overlap in the wing length of these forms, although measurements of 83 breeding males did not reveal any.

However, Cherrie later secured a typical gray-cheek at San Domingo City during spring migration. It was taken May 1, 1896, and has a wing of 103 mm. The larger form, then, must migrate through the islands to some extent.

Of the capture of these specimens Cherrie (1896) writes: "Single specimens were noted on three occasions; twice high up in the mountains — above Aguacate — on the 22nd and 25th of February and one at San Domingo City on the coast May 1. All were males and extremely fat." Aguacate is on the south coast of the island.

The next Dominican specimen, likewise recorded as *aliciae* (Verrill, A. E. and A. H., 1909), was collected at Sanchez by Verrill, December 27, 1906. The specimen went to the Rothschild collection in the Tring Museum, where Wetmore examined it and found it to be a Bicknell's thrush. The specimen has now fortunately come to the American

Museum, where it is more available. It appears to be an example of the olive phase, indicating that both phases of the smaller form may have coincident winter ranges as well as summer ones. It is a male with a wing of 94 mm.

Sanchez is a coastal town situated on a steep hillside. Back of the town is a mountain range 3500 feet in elevation and covered with dense tropical forest. It is a region of heavy rainfall. The winter temperature is given as 84° F. which probably slightly exceeds summer temperatures in the New England mountains where the thrushes breed. No statement was made indicating that the specimen was taken in the mountains, but it seems probable that "near Sanchez" may have meant that. It was erroneously recorded as a migrant, though taken January 27.

The one record from the adjacent Republic of Haiti was reported by Bond (1928) as a *Hylocichla minima* subsp., taken January 19, 1928 on Morne Malanga. "It was taken in the dense fern growth." Wetmore and Swales (1931) think this is probably the specimen referred to by Lonnberg (1929) as taken by Ekman in January 1928 which Lonnberg informs them in a letter is a Bicknell's thrush.

Thus it seems that where formerly there were no winter records for Bicknell's thrush in the West Indies and more than a half dozen for *aliciae*, through re-identifications the picture is reversed; now there are no positive winter records for the larger form but seven probable ones for the smaller.

### *South America*

As already intimated, though this continent has repeatedly been postulated as the winter home of Bicknell's thrush, all the South American records for the smaller race seem very dubious.

The question of the erroneously identified type need not be re-introduced here. At the time of its restoration Bangs added that it was "the southernmost record of the subspecies, which otherwise has not been found wintering in South America." In Part I, under Nomenclatural Review, mention was made of a few other early South American specimens that had been questioningly referred to Lafresnaye's *Turdus minimus* and then buried with it when the type became synonomized with the olive-backed thrush. Obviously these other examples should have been re-examined after the restoration of Lafresnaye's bird, but no one seems to have been concerned about it; and now that the old type locality, Bogota, seems to be south of the winter quarters of the smaller form,

there is less incentive to run down these early records. They may be briefly mentioned, however, to disclose any bearing they may have on the subject.

Sclater (1855) mentions a *T. minimus* received in a collection of Bogota birds, but dismisses it as a synonym of *T. minor* (the olive-back). Later (Sclater, 1859) he reports another example from Rio Napo, Ecuador. He also mentions an earlier Ecuadorian bird received by Mr. Gould from Quijos which he listed as *T. minimus*, saying: "The Prince Charles Bonaparte has reunited this bird to the 'minor' of the United States, from which M. de la Fresnaye considered it distinct." (Sclater 1854). In 1860 he indicated his complete confusion over the identity of all these similar hylocichlid thrushes by lumping specimens from southern Mexico and Guatemala as hardly separable from Lafresnaye's new Grenadian *T. minimus* (Sclater, 1857).

These specimens have proven practically impossible to locate. N. B. Kinnear of the British Museum, where Sclater's birds should be (apparently some of the specimens in question were not his but merely reported by him), writes in a letter that the Bogota specimen mentioned above is an olive-backed thrush, but that though they might have the other specimens they could not be sure they were the ones referred to by Sclater. In the light of our present knowledge of the winter distribution of *Hylocichlae*, however, the possibility of securing Bicknell's thrush in Ecuador seems exceedingly remote, since even the northern gray-cheeks for the most part winter north of that region. Probably the Ecuadorian specimens mentioned were also olive-back thrushes, which in general winter farther south than the gray-cheeks.

Bryant (1860) had one (or two?) specimens of an unidentified thrush from Bogota which he said "agree with Lafresnaye's description" and "are certainly distinct from the North American *T. swainsoni*." Therefore he maintained that Lafresnaye's name of *minimus* should be restored. He gave the wing length as 3.75 inches (equivalent to 95.3 mm.) and quite carefully described the plumage, but unfortunately omitted all mention of such diagnostic characters as the eye ring and cheek region. Baird (1864), admitting it was different from *swainsoni*, believed it was nevertheless not wholly distinct from it. Bryant's collection, unfortunately, was dispersed among so many different institutions that all attempts to locate the specimen have been unsuccessful. According to the wing measurements given it would more likely be a Bicknell's than a gray-check; but the possibility of its being an olive-back is by no means

out of the question, its winter habitat in Bogota suggesting the latter identification.

George Lawrence (1867) also had a thrush of doubtful identity from Panama of which he wrote "My specimen is certainly distinct from *swainsoni* and in measurements agrees with those of Lafresnaye and Bryant, but in coloration does not agree with either." Awaiting further light, and an examination of the type by a competent judge, he tentatively referred the specimen to *T. minimus*.

Baird believed Lawrence's specimen was simply an olive-back. This bird, like Bryant's, has eluded all attempts to trace it down.

The 1931 *A.O.U. Check-list* complicated matters regarding the winter distribution of this form. Though the type locality was given as Bogota, Colombia, the winter range was given as Haiti and Venezuela. Perusal of all the South American ornithological literature available failed to disclose the basis of the check-list record or records from Venezuela. Practically every member of the check-list committee, and many museum curators, were consulted; but the Venezuelan winter records for Bicknell's thrush still remained a mystery. Later, quite by accident, Dr. Bishop of Pasadena, California, wrote that his New Haven collection of birds included one specimen of Bicknell's thrush from Venezuela. This undoubtedly was the basis of the check-list statement, since Dr. Bishop submitted many records to the committee.

During the past summer, however, Dr. Bishop kindly loaned me his entire collection of Bicknell's thrush. The Venezuelan specimen in question had wing lengths of 97 and 98 mm., and was sexed as a male, which places it on the borderline between the two size forms of this species. The bird was one of Gabaldon's specimens from Nevador, and in view of his unfortunate reputation for mistaking the sex of birds it seems likely that the bird is wrongly sexed, which of course leaves no doubt as to its identity. Fleming has eight specimens of the larger form from Merida and from the same collector. One of these, sexed as a male, is slightly below the minimum for males of the larger race; but its exact similarity to the other specimens suggests that it may be wrongly sexed rather than actually a Bicknell's thrush. Another specimen in the collection, sexed as a female, had a wing length of 104 mm., a maximum rarely attained by gray-cheek females; this fact likewise suggests that Gabaldon may have been careless in sexing specimens. All these Merida birds then, which were fall (mostly October) rather than winter specimens, seem to be referable to the northern gray-checked thrush.

The last straw in the campaign for Bicknell's thrushes in Venezuela came when a list of specimens from the Brooklyn Museum unexpectedly included two specimens of that form from El Loro and Nevador, Venezuela, taken October 16, 1904 and November 14, 1903 respectively. However, these specimens were examined at the Brooklyn Museum last spring (1935) and found to be typical examples of the olive-backed thrush. Thus, the Check-list notwithstanding, there seem to be no trustworthy records of Bicknell's thrush in Venezuela.

The American Museum has a fairly large series of gray-checked thrushes from Santa Marta regions of Colombia, such as Bonda, Onaca, and Valparaiso, some of them closely approaching the maximum dimensions of the smaller form. The specimens are unsexed, however, and it seems probable that the small birds merely represent the females, and if so there are no likely specimens of the smaller form in the collection.

From this rather extended review of possible records of Bicknell's thrush in South America it should be clearly evident that as yet there is no trustworthy specimen evidence of the occurrence of the smaller form on that continent. In spite of this contradictory evidence, however, there still remains the possibility that some of them may winter in the extreme northern part of the continent, reaching it either by flights from the West Indies or from Central America. It is difficult to explain the fact that this form unquestionably migrates through northwestern Georgia and presumably Alabama and Louisiana without assuming that they cross the Gulf, destined for some more southern point. It seems hardly logical that they would swerve eastward across Cuba to Haiti. It is more plausible that they cross the water to Yucatan and then go southward an unknown distance to an unknown winter home, possibly somewhere in northern South America. There are no records, either in migration or winter, of this form in Central American regions, aside from the two uncertain cases previously cited. Pending further specimen information, this western route, resting as it does on only a few dubious records, must be regarded merely as hypothetical.

With all the South American records, then, falling into disrepute, only the island of Haiti is left as the known winter home of Bicknell's thrush. This is based on four indubitable specimen records and three probable ones.

*Winter Distribution of Gray-checked Thrush*

No attempt has been made to investigate all the records of the larger form in South America; but in the course of analysis of records, chiefly

with the view of finding possible examples of the smaller form, some 30 or more specimens have been examined which, together with as many more unexamined specimens, gives some idea of the winter range of the gray-checked thrush on that continent. In view of the paucity and scattered nature of published records a brief tabular summary of these, including Central American and West Indian migration records, may prove useful.

San Domingo, San Domingo City; ♂; May 1, 1895; Cherrie; W. 105.
Cuba: (Gundlach, 1871).
Yucatan, Cozumel Is.: April 30, 1885; Gaumer; W. 96; (B. M.)* (Salvin, 1888).
Bay of Honduras, Ruatan Is. 1886; Gaumer; W. 95; (B. M.) (Salvin, 1888).
.....: 1886; Gaumer; W. 102; (B. M.); (Salvin, 1888).
Campeche, San Antonio: ♂; April 25, 1888; W. 105.5; (B. M.).
Guatemala: W. 98; (B. M.).
.....: (May be same as above); (Salvin and Godman, 1904).
.....Peten, Uaxactum: ♂; April 28, 1931; Van Tyne; W. 105–7;
Honduras and Salvador: (Salvin and Godman, 1904).
Costa Rica, San Jose: Frantzius; (Lawrence, 1868).
.....Carillo; ♂; November, 1898; W. 102; (B. M.).
.....Azahar Cartago: ♀?; October 20, 1900; W. 104; (Fleming).
Panama, Volcano de Chiriqui; ♂; W. 106.5; (B. M.); (Salvin, 1870).
Venezuela, Merida:

| | | | | |
|---|---|---|---|---|
| Fleming ♂ | Nov. 11, 1911 | Gabaldon | W. 104 | |
| Fleming ♂ | Oct. 29, 1907 | Gabaldon | W. 98 | |
| Fleming .. | Oct. 24, 1907 | Gabaldon | W. 101 | |
| Fleming ♂ | Nov. 11, 1907 | Gabaldon | W. 97 | (wrongly sexed?) |
| Fleming ♂ | | Gabaldon | W. 102 | |
| Fleming ♀ | | Gabaldon | W. 99 | |
| Fleming ♂ | Oct. 24, 1904 | Gabaldon | W. 99.5 | |
| Fleming ♂ | Oct. 20, 1903 | Gabaldon | W. 102.5 | |
| L.B.B. ♂ juv. | Oct. 28, 1903 | Gabaldon | W. 97–8 | (wrongly sexed?) |

*British Museum.

Venezuela: ♂; January, 1885; W. 106; (B. M.).
.....Quiribana de Caicara, Orinoco River: (Berlepsch & Hartet, 1902).
.....Maipures, Orinoco River: (Berlepsch & Hartet, 1902).
.....Nicare, Cuara River: (Berlepsch & Hartet, 1902).
.....La Princion, Cuara River: (Berlepsch & Hartet, 1902).
(specimens taken in last four localities: Jan., Feb., Apr., Dec.).
.....El Loro; ♂; Oct. 10, 1904; W. 102–3; (Brooklyn Museum).
.....Mt. Duida: ♂'s; December 15, 1928; March 7, 1929; W. 102 and 106 (M.C.Z.).
Colombia, Bogota: January, 1848; Lafresnaye; W. 99; (Lafresnaye, 1848).
.....: Bryant; W. 95.3; (Bryant, 1860).
.....: W. 101; (B. M.).
Colombia, Minca, Santa Marta: ♀; January 22, 1879; W. 108; (wrongly sexed); (B. M.).
Colombia, Santa Marta: 2 ♂'s; winter resident; (Bangs, 1898).
Colombia, Bonda: October 7–November 28, 1898; W. 96, 96, 97, 99, 99, 100.
Colombia, Las Nubes: December 17, 1898.
Colombia, Onaca: December 26–28, 1898; W. 96, 98.
Colombia, Valparaiso: March 18, 23, and April 7, 1899; W. 99, 96, & ?.
(These last four localities are represented by 16 specimens—gift of Morris K. Jessup to American Museum. J. A. Allen, 1900).
Colombia, Bucara Manga: (J. A. Allen, 1900).
Colombia, Puerto Valdivia: December 18; (Chapman, 1917).
Colombia, Magdalena, Rio Frio: (Darlington, 1931).
Ecuador, Quijos and Rio Napo: olive-backs? (Sclater, 1854, 1859).
Ecuador, Machay: ♀; November; (Taczanowski and Berlepsch, 1885).
Peru, Chamicuros: ♂; March 30, 1868; (southernmost record); (B. M.); (Seebohm, 1881).
British Guiana—easternmost records:

| | | | | |
|---|---|---|---|---|
| Bartica Grove: | ♂ | Feb. 2, 1890 | W. 100 | (B. M.: Salvin, 1885). |
| Camacusa: | ♂ | Mar. 29, 1882 | W. 99 | (B. M.: Salvin, 1885). |
| Kamakusa: | ♀ | Jan. 28, 1923 | W. 98 | (American Museum). |

# PART III

# THE HOME LIFE OF BICKNELL'S THRUSH

## Introduction

The third part of this research, dealing with the home life of Bicknell's thrush, is based on field studies conducted on Mt. Mansfield, in the north-central part of Vermont about twenty miles east of Burlington. Two summers were spent here, the first in 1933 from late June until September and the second in 1935 from late May to September 9. Most of the nesting data comes from observations in 1935, since in 1933 the birds were nearly through breeding by late June. Some preliminary attention is given to climatic and ecological aspects of the region because of their fundamental importance to nesting birds.

## The Mt. Mansfield Region

### *Physiographical Features*

In origin the Green Mountains of Vermont date back to the Taconic Revolution which marks the great unconformity between the Ordovician and Silurian geological periods. At that time the sediments in the northern part of the Appalachian trough were folded up into massive mountain ranges; but in the subsequent millions of years the processes of erosion and repeated glaciation have worn them down to mere stumps of their pre-Silurian greatness. And the heritage now left to the Green Mountain state from these geological upheavals of the past is the relatively low, but rough and rocky mountain ranges in which every Vermonter takes pardonable pride.

The two hundred mile chain of mountain peaks that extends through the state from Massachusetts to Canada attains its culmination of height and interest in the Mt. Mansfield region, with Mansfield itself as the central and dominating feature. This is the highest of the Green Mountains, attaining an elevation of 4,393 feet. Though such an altitude seems low in comparison with western mountains, it must be remembered that New England hills rise from practically sea level, whereas the Rockies rest on a base that is a mile high.

Since early times Mt. Mansfield has been likened to the upturned face of a recumbent man, the major features of the summit from south to north appropriating the names: the Forehead, the Nose, and the Chin,

the latter representing the highest point. The skyline ridge from the Forehead to the Chin, most of which is rocky and treeless, is more than two miles in length, and lateral as well as northern and southern extensions into additional ridges greatly increases the total acreage of the summit. Three of these rocky additions are known as Maple Ridge, Sunset Ridge, and Bear Ridge; only the latter being wooded. And just north of the Chin rises a rounded promontory, the Adam's Apple. In a depression formed by the steep bluffs near the Adam's Apple lies the shallow but beautiful Lake of the Clouds, a permanent drainage pool nestled like a glistening jewel in a somber setting of balsams. The extensive, firry bluffs surrounding this pool provide ideal breeding grounds for Bicknell's thrush, but the dense balsams effectively resist intrusion.

Though the majority of Vermont's four hundred or more peaks are wooded over the top, Mt. Mansfield is a notable exception in having a summit above the tree limit. To the true timber line may be added a few ledges, which, though once forest-clad, were denuded by fires more than a decade ago and have not been able to regain lost footing. The sky line, then, is mainly of the open, boulder-strewn, wind-swept type, exposed the year around to elements that are far from mild. Glacial boulders heaped irregularly about the summit; huge caverns and underground passages; fissures and caves in the rocks, some of which retain winter's snow and ice till midsummer, are among the features that add interest to the mountain's rugged topography.

In spite of constant exposure and rocky substratum, however, every available crevice and foothold is taken over by hardy plants in their perpetual struggle to revegetate nature's barren areas. Mosses and lichens of great variety and beauty, wiry sedges, hardy herbaceous plants and ericaceous shrubs continually battle for their place in the sun. And in every sheltered hollow, and fringing the sides of every promontory and barren ledge, stand the advance guards of the tree line, the matted, storm-dwarfed groves of balsam, birch, and spruce so characteristic of high altitudes. Trees, many decades and possibly a century old, yet only a few feet tall, get beaten back each year as much as they can advance.

### *Climatic Considerations*

Indications of the climatic severity prevailing at high altitudes have already been suggested. Meteorological data are not available for Mt. Mansfield, but G. M. Allen (1902) gives some temperature and wind velocity readings for Mt. Washington which illustrate climatic conditions

on New England mountains with a timber line. The mean annual temperature for the six years between 1853 and 1859 is given as 28° F. For the months from October to March, which at that altitude are practically winter, the mean temperature was 12.4° F. During June, July, and August, which may be taken as the breeding period of the birds, the average monthly temperature for six years was 45.5°, 47.9°, and 50.7° F. respectively. Wind velocities at this elevation, particularly during storms, are frequently terrific. "A wind velocity of 140 miles per hour has been measured, and during one night the mean of four observations is given as 128 miles."

These readings obtained on Mt. Washington, of course, would not strictly apply to a peak of lower elevation such as Mt. Mansfield, but they probably are not unduly exaggerated. Summer gales on Mansfield are so severe that it is often difficult to maintain one's footing against the strong wind. Storms are usually local, for not infrequently during them the valley inhabitants below may experience perfect calm. Thunder showers are an attractive yet fearful sight as the flashes of lightning play about the rocky crests of the mountain's face. Though in periods of calm in winter it is a well-repaid expenditure of energy to ascend the summit on snowshoes, during rough weather it can be accomplished only at the risk of one's life.

Rainfall measurements appear not to be available for any New England mountains, but the fact that high altitudes are in the path of low floating clouds results in frequent local showers and almost constant mists. Even when fair weather prevails in the lowlands the summit of Mansfield is often enveloped in clouds that may lift for only a few hours a day. Nearly every morning mists rise up from the river valleys below and drift over the summit, sometimes to linger throughout the day, sometimes to be quickly dispelled. And then, in addition to precipitations from above, in spring there are the great banks of melting snow which must either be absorbed or delivered to the valleys below.

The retardation of spring naturally resulting from the climatic conditions just enumerated is a well known feature of high altitudes. An hour of brisk hiking in early June will take one from a region where spring is nearly past to a region where it is hardly begun. Trees have been in full leaf for a month at the foot of the mountain, but above 3000 feet they are still in bud. Flowers that bloomed in April below, if represented at all near the summit, may, in early June, be barely emerging through the recently thawed ground. The fronds of spinulose ferns are just beginning

to unfold, spring beauties just opening their pretty eyes near the rapidly retreating brink of a snow bank, and in low wet places beside a brook the leafy shoots of white hellebore are pushing up through the ground. While robins may be attempting a second or even third nesting in the valleys, spring migrants have barely arrived at the summit and even the juncos have not begun to build.

* * *

Needless to say so many challenging items of interest led to Mansfield's early conquest by man, and at the present time it is both the most accessible and most popular of the Green Mountains. A public highway maintained through the famous Smuggler's Notch brings one to the foot of the mountain, and a toll road, open from June till October, permits motoring to the summit (though not to the highest points) of the mountain. Here an ideally located hotel, with many modern conveniences, efficently managed by congenial and accommodating proprietors, welcomes summer visitors of both the tourist and hiking class. In addition to a new camp intended primarily for winter skiing quarters, there are two Long Trail log cabin lodges open the year around for the accommodation of hikers. More than twenty foot-trails have been blazed over the mountain, thus penetrating the very heart of formerly inaccessible solitudes. And though this is not the proper place to digress I can think of few more inspiring sights than standing on a lookout with nearly all of Vermont and parts of New York, New Hampshire, and southern Canada stretched before one's gaze. The diameter of one's range of vision on a clear day is more than a hundred miles, and the circumference, or horizon line, is nearly 500 miles in extent.

### *Life Zones*

In dealing with the interesting biological character of such diversified areas it may be most instructive to characterize the gradations in the plant and animal life encountered in ascending the mountain. Rising a few thousand feet in elevation is in many ecological respects equivalent to going that many miles northward. The lower altitudes will be briefly discussed since they enter only casually into this account.

The lower 2000 feet of Mt. Mansfield is composed of a definite vegetational unit known to ecologists as the Beech-Maple Forest Association. Here and elsewhere in Vermont it is the most wide-spread plant association, probably representing the climax type toward which all other woodland areas are gradually progressing, although in many areas extensive

stands of conifers, red spruce (*Picea rubra*) and hemlock (*Tsuga canadensis*) still prevail. The coniferous association cannot by any natural processes be expected to replace the Beech-Maple forest, so at the present time artificial measures are being undertaken on Mansfield to re-introduce the spruce by girdling the hardwoods.

Without attempting to draw a line between dominant and secondary species some of the representative plant species in this association may be enumerated. In addition to the maple (*Acer saccharum*) and beech (*Fagus grandifolia*) occur scattered samples of hemlock (*Tsuga canadensis*), yellow and paper birch (*Betula lutea and Betula papyrifera*), white ash (*Fraxinus americana*), ironwood (*Ostrya virginiana*), and basswood (*Tilia americana*). Selected examples of the ground flora are hepatica (*Hepatica triloba*), cucumber root (*Medeola virginiana*), white and red baneberry (*Actea alba* and *Actea rubra*) and, later in the summer, pale and spotted touch-me-not (*Impatiens pallida* and *Impatiens biflora*). Inhabiting woodlands of this type occur typically sub-Canadian birds such as the yellow-bellied sapsucker (*Sphyrapicus v. varius*), wood pewee (*Myiochanes virens*), hermit thrush (*Hylocichla guttata faxoni*), blue-headed vireo (*Vireo s. solitarius*), black-throated blue and green warblers (*Dendroica c. caerulescens* and *v. virens*), and scarlet tanager (*Piranga erythromelas*). The chipmunk (*Tamias striatus lysteri*) is the outstanding mammalian inhabitant of this zone.

The zone between 2000 and 3000 feet may well be regarded as transitional in character, connecting the deciduous hardwoods with the belt of conifers above. Forms from both areas (above and below) meet and mingle on this intermediate ground; but some forms attain their peak of abundance here and may be considered characteristic of this zone. The Beech-Maple elements, except for birch, gradually thin out, giving way first to thickets of shrubs, such as mountain maple (*Acer spicatum*), hobble bush (*Viburnum alnifolium*), and red-berried elder (*Sambucus racemosa*), until they finally merge with the evergreens from above. The winter wren (*Nannus h. hiemalis*), though common to the whole mountain, probably reaches its greatest abundance in this area, and the olive-backed thrush (*Hylocichla ustulata swainsoni*) for the most part is restricted to it.

The area from 3000 feet up to the limit of timber, which is the optimum zone for Bicknell's thrush, justifies more careful consideration. In this zone are found dense coniferous groves whose constantly varying density is usually correlated with elevation. They occur as continuous forests in

favorable areas or as scattered patches on the rocky, element-exposed ledges. These stands consist chiefly of balsam (*Abies balsamea*), spruces (*Picea rubra* with occasional specimens of *Picea mariana* at the very top), and birches. Both the yellow birch (*Betula lutea*) and paper birch (*Betula papyrifera*) occur, but the scrubby summit birches, sometimes spoken of as dwarf *lutea*, are actually *Betula papyrifera* var. *minor*. *Betula glandulosa*, an arctic-alpine species, presumably also appears on the summit of Mansfield, but its specific distinctness is hard to demonstrate.

On the southwestern slopes of the Forehead, in the vicinity of Mabel Taylor Butler Lodge, where some of my nesting studies were conducted, there are the additional complications that pyric factors introduce. Many of the ledges were burned over about fifteen years ago, resulting in the invasion of exotic types before gradual reforestation by second growth balsam and birch. Fire-charred stumps and logs remain as vivid testimony of past pyric destruction both in the open areas and among the trees.

The birch and balsam forests of this area consist, not of open groves, but of dense tangles of both dead and living trees. Dead relics of former generations tower like stark sentinels over the smaller secondary growth. Others in the process of falling are partially supported by standing trees, or having fallen to the ground project their sharp branches to bar an intruder's way. Where fallen monarchs have cleared an opening in a patch of timber, deciduous bushes such as pin cherry (*Prunus pennsylvanica*), mountain ash (*Sorbus americanus*), and hobble bush (*Viburnum alnifolium*) quickly spring up in advance of slower growing trees. There is always an abundance of tall ferns, mostly *Aspidium spinulosum* var. *dilatatum*, mingled with the underbrush.

At successively higher altitudes the stands of fir become denser and more dwarfed, until at the tree limit they are so closely matted together that they are often virtually impenetrable. Indeed, their branches may be so closely interlaced that it is sometimes possible to walk over the tops of them without sinking through. Where the trees are taller, however, it is usually possible to crawl under or force a way through. Trails have conveniently opened up many formerly inaccessible areas, and now only a freak ornithologist would think of leaving the trails for more than a few feet. But thrushes do not nest on the trails. The discouragingly dense tangles in which Bicknell's thrushes dwell have kept their habits long wrapped in mystery.

The extensive treeless areas about the summit of Mansfield support an abundance of hardy shrubs and alpine herbaceous plants. Curiously enough, many of these montane forms, growing in the dry sandy soil on the rocky heights, reappear in northern lowlands in bogs and marshes. This probably reflects the fact that bog soil, although surrounded by ample water, is actually dry physiologically due to lack of oxygen, and that mountain summit soil, although saturated daily by passing clouds, is physically dry due to the rocky substratum as well as to the drying effect of constant winds. Thus it appears that these seemingly widely different habitats, the bog and the mountain, may be more similar than would be expected at first sight, and that xerophytic plants, often of identical species, are characteristic of both.

A few of these interesting shrubs are: *Amelanchier oligocarpa*, a species of juneberry found in the swamps of Labrador and on the New England mountains; the mountain holly (*Nemopanthus mucronata*), whose bright red berries are so conspicuous in late summer; and a number of *Ericaceae* such as labrador tea (*Ledum groenlandicum*) whose feathery bloom whitens the rocks like returning snow in early summer, *Andromeda glaucophylla*, *Chaemedaphae calyculata*, and *Arctostaphylos alpina*(?). ericaceous plants reach their culmination on Mt. Mansfield in the great abundance and variety of the *Vacciniums* over whose identity even the professional botanist might knit his brow. The bilberries (*Vaccinium ovalifolium*) and mountain cranberries (*Vaccinium Vitis-Idaea* var. *minus*) are truly indigenous forms, but most of the blueberry species are probably introduced in the wake of fires which increase the potash content of the soil.

Herbaceous plants attain a luxurious development both in the shelter of the fir forests as well as out on the exposed ledges. Under the balsams the trifoliate leaves and pretty blossoms of the white-wood sorrel (*Oxalis acetosella*) form an endless carpet, decorated profusely with clintonia (*Clintonia borealis*), bunchberry (*Cornus canadensis*), mountain goldenrod (*Solidago macrophylla*), sharp-leaved aster (*Aster acuminata*), and the trailing vines of the snowberry (*Chiogenes hispidula*). Above the tree limit every available niche in the rocks is taken over by wiry grasses and sedges, and clusters of mountain sandwort (*Arenaria groenlandica*). Less frequently one encounters *Potentilla tridentata*, and the interesting crowberry (*Empetrum nigrum*).

The lower forms of plant life, the ferns, mosses, and lichens play a fundamental role in the ecology of the high altitude and many a spe-

cialist has been led to clamber over rocky ledges for sources of rare finds in these fields. The abundance of *Aspidium spinulosum* var. *dilatatum* has already been mentioned, but two other varieties of this species also occur. The many cliffs and boulders naturally form an ideal habitat for the rock fern (*Polypodium vulgare*) and the bladder ferns (*Cystopteris bulbifera* and *C. fragilis*), as well as many other forms. They also may frequently be cushioned with mosses or covered with lichens. The pretty strands of *Calliergon* and other hypnaceous mosses as well as beds of *Sphagnum* cover extensive areas under the balsams, which may in turn be bearded with death-dealing lichens.

Only five species of mammals are conspicuously abundant in this upper zone. The never-to-be-forgiven porcupine (*Erethizon dorsatum dorsatum*), which is so destructive to camps and lodges in the mountains, manages to survive the attacks of exasperated campers in considerable numbers in spite of its low breeding rate. The virginia varying hare (*Lepus americanus virginianus*) is a common and better loved companion of Long Trail hikers. Red squirrels (*Sciurus hudsonicus gymnicus*) are altogether too abundant and appear to be the worst predatory enemy that nesting birds have. Two mice, the white-footed wood mouse (*Peromyscus maniculatus gracilis*?) and the red-backed vole (*Clethrionomys gapperi gapperi*), are common in the woods and about the lodges, the former in particular having an unsavory reputation for mischievousness. In addition, weasels (*Mustela*), raccoons (*Procyon lotor lotor*), northern white-tailed deer (*Odocoileus virginianus borealis*), lynx (*Lynx*), and (more rarely) black bears (*Euarctos americanus americanus*) are sometimes seen.

## Summer Bird Life

The avifauna of the Mt. Mansfield region, however interesting and intriguing a subject, falls largely outside the scope of this work and can be dealt with only briefly here. Howell (1901) published a preliminary list of Mt. Mansfield birds based both on his own observation and on records supplied by Mrs. Straw, a resident of Stowe valley. Mrs. Davenport (1903) compiled a list of records for the region, a copy of which is kept at the Summit House, but observations during recent summers suggest that this list needs both supplement and revision. Bird lists compiled for the White Mountains (Chadbourne, 1887; Faxon and F. H. Allen, 1888; G. M. Allen, 1902) appear not to be strictly applicable to the Green Mountains, since birds reported as common there, such as the Canada jay, pine grosbeak, and Acadian chickadee, are either rare or totally

absent in summer about Mt. Mansfield. Thus there seems to be an urgent demand for supplementary observations on the avifauna of the mountainous districts of Vermont.

Disregarding this gap in our ornithological knowledge of the region, brief mention should be made of the birds that occur as breeding companions of Bicknell's thrush. The bulk of the relatively dense bird population is composed of a small number of forms, not more than a dozen species being common above 3000 feet.

Though not the most conspicuous, the black-poll warbler (*Dendroica striata*) is unquestionably the most abundant bird about the summit of Mt. Mansfield. Even before the snows of spring have disappeared great numbers of these dainty inquisitive warblers fill the evergreen groves, repeatedly uttering their soft and tinkling melody. Neither brilliant in plumage nor accomplished as singers, they often go unnoticed in spite of their abundance; but nearly every quest for a Bicknell's nest revealed several of the neat, well hidden nests of this interesting bird.

The ever-present white-throat (*Zonotrichia albicollis*), whose pure sweet whistle is so vital a part of the mountainous solitude, is perhaps the most noticeable as well as the most popular bird in the region. Though wide-spread throughout both upland and lowland they belong in particular to the zone just below the summit, seeming to sing more lustily and more constantly at high altitudes. From dawn until dark their clear sweet whistle is seldom silent. Once one was heard to sing an eighteen-syllable song without a break, instead of the usual five or six phrases. Twelve-syllable songs were not uncommon. In spite of heavy mortality to their nests, by repeated attempts they ultimately emerge triumphantly with a family of youngsters.

No bird in the mountains can tolerate the bleak conditions of the timber-line as well as the junco (*Junco h. hyemalis*). Abundantly distributed over the whole Mansfield region from the sub-Canadian woods to the very summit, it is dependent on trees neither for food nor nesting sites and can eke out a living among the low shrubs and grasses surrounding the barren rocks.

The winter wren (*Nannus h. hiemalis*) is an often heard but seldom seen inhabitant of the area. The abundant moss-covered logs, dense tangles of brush, and trickling rivulets provide a perfect home for this elusive songster. Nearly every Bicknell's nesting territory included a pair of these friendly neighbors, whose welcome and continual cascade of melody was a delight to hear.

The wary olive-backed thrush (*Hylochichla ustulata swainsoni*) is always present in considerable numbers between 2000 and 3500 feet, thus forming a connecting link between the Bicknell's thrushes above and the veeries and hermits below. On the northeast side of Mansfield, in 1933, the Bicknell's and olive-backs were not found together, being effectively segregated by the 3500-foot elevation line; but on the southwest side they distinctly overlapped, and nests of both in close proximity were found at less than 2900 feet and at more than 3000 feet.

Along the ferny haunts of the brook and in the depths of the hellebore and turtlehead bogs, the yellow-bellied flycatcher (*Empidonax flaviventris*) might be completely overlooked, did not his abrupt attempt at song constantly advertise his whereabouts.

In the coniferous groves occurs a varied assortment of birds that seem to fluctuate considerably in numbers. On the north and east side of the mountain in 1933, large flocks of golden-crowned kinglets (*Regulus s. satrapus*) emerged with their young in July, but on the southwest side, in 1935, very few were seen. The red-breasted nuthatch (*Sitta canadensis*) although scattered in pairs over the whole area, also seemed more abundant on the north side. Black-capped chickadees (*Penthestes a. atricapillus*), on the contrary, seemed to prefer the mixed woods on the southwest side, where they were very common. Its brown-capped relative, the Acadian chickadee (*Penthestes hudsonicus littoralis*), is supposed to be a part of the breeding avifauna of the Green Mountains; but though constantly watched for only one solitary individual was seen, and that in early September long after the breeding season. The brown creeper (*Certhia familiaris americana*), however, does breed sparingly in the tall groves of fir and spruce, and on July 10, 1933, I encountered adult birds educating their mottled young to the proper methods of clinging to vertical tree-trunks, a rather difficult procedure for half-tailed youngsters.

My early recollections of myrtle warblers (*Dendroica coronata*) on Couching Lion is that they were fully as abundant as black-polls; but that certainly is not true of Mansfield during recent years. They were present in scattered pairs, however; but only three of their nests were found, in comparison to nearly two dozen nests of the black-poll. Canada warblers (*Wilsonia canadensis*) were more common at 3000 feet than myrtles, but were more restricted to the lower altitudes. The loud pleasing warble and dainty little nest tucked away under the roots of a small tree are among the summer's unforgettable memories.

Two interesting finches occur as summer residents. The rich, joyous warble of the purple finch (*Carpodacus purpureus*) is a vital part of the bird life in the evergreens, and nearly every grove has its nesting pair. White-winged crossbills (*Loxia leucoptera*) also are present in considerable numbers in the same areas but invariably are seen as roving bands, feeding awhile in one area, then wheeling aloft with musical twitters to sail away for other foraging grounds, perhaps not to be observed again for several days or several weeks. Though they must nest somewhere about the summit of Mt. Mansfield I have never been able to locate an actual nesting site.

The only well represented gallinaceous bird is the Canadian ruffed grouse (*Bonasa umbellus togata*). This form seems exceptionally abundant for a game bird, not only in the sub-Canadian (Beech-Maple) woods, but even more so about the upper ledges just below the tree limit.* A pair of these reared a brood of seven (from a nest of eight eggs) back of our cabin.

Birds of prey find suitable nesting sites and ample foraging grounds about the rocky ledges. Duck hawks and supposedly bald eagles nest on a few of the inaccessible cliffs, though the red-tailed hawk is probably the most common of the larger birds of prey. Sparrow hawks and doubtless both sharp-shinned and Cooper's hawks are frequently seen dashing into concealment. How serious their depredations upon the passerine bird population may be is uncertain; but probably the abundant wood mice, voles, and chipmunks form their staple articles of diet.

But perhaps the most characteristic bird about the wooded portions of the summit, and one which is wholly restricted to the upper zone, is Bicknell's thrush. Except for the black-polls and white-throats, it is undoubtedly the most abundant inhabitant of the stunted evergreens, and, as is hardly necessary to add, it is by far the most interesting. The mystery that has surrounded its nesting behavior so long, its wildly fascinating song which in early June is so noticeable, its peculiarly restricted distribution and other singular features, combine to make it a particularly challenging bird for study. The following account traces its summer cycle from the time of arrival on the breeding grounds in spring to its departure in fall.

---

*Returning to Mansfield the following summer I found this cyclic bird notably scarce.

## Arrival on Breeding Grounds

Though actual observations on the return of Bicknell's thrushes to their breeding grounds are very limited, several sources of information permit setting the approximate date with reasonable accuracy.

Walter Faxon (G. M. Allen, 1902) found them returning to Mt. Moosilauke in New Hampshire between the 25th and 30th of May.

Davenport (Mt. Mansfield Hotel bird list) reported one singing May 25, 1904, though the notes were not full and clear. Snow drifts were 3 feet deep under the ledges.

Migration data from southern New England and New York indicate that migrants appear as early as May 15 (2 specimen records—Bishop collection) and (rarely) linger as late as June 11 (Wright, 1908—specimen, M.C.Z.); but the vast majority of specimen-verified records fall between the 20th and 30th of May. Only two records are later than May 30th.

C. J. Maynard (1910) reported observing about 12 pairs of Bicknell's thrushes on Mt. Greylock in the Berkshires between May 28 and 30. Since only one or two pairs had previously been reported to summer on Greylock it is probable that some of Maynard's singing birds were northbound transients.

Observations on Mt. Mansfield during the season of 1935 supplement these records for that particular region. The first trip to the summit was taken on May 27, in the late afternoon. One bird called queryingly a half dozen times as we penetrated his partially snow-bound domains during early dusk. Later, one called above Taft Lodge, but no songs were heard, either denoting a scarcity of thrushes returned, or else unusual quietness on their part, for it is at twilight that they are most musical. May 27, 1935, fell on the second warm day succeeding nearly a month of cold exceptional even for Vermont. Though no snow remained in the valleys, the last lap of the hike to the lodge was made by ploughing through banks of snow several feet deep, and about the top of the mountain the snow was almost continuous in the trails and in the woods; but the heavy warm rains that came that evening and on the following days served to dispose of much of it. It seems probable, therefore, that few if any thrushes returned to their snow-bound haunts this season before May 26. but that they moved in gradually during the ensuing days.

On the following day, May 28, Bicknell's thrushes seemed fairly well represented; and the first song, a rather feeble, twice-repeated effort, was heard during the course of the forenoon. That evening a bird in the

vicinity of Taft Lodge burst into full-throated song and sang in circles about the cabin, once appearing visible in the dim light as he perched restlessly on a big birch near the cabin.

On May 29, songs were quite frequent along the three-mile stretch of snow-and-slush-filled trails across the summit of the mountain. On May 31, the evening chorus, to be described later in more detail, seemed to have swelled to full proportion; and, although some of the singers may have been migrants bound for more northern breeding grounds, their ranks on subsequent evenings surely suffered slight if any diminution in numbers, being filled in by later migrants if any of the earlier ones left.

It may therefore be concluded that during the season of 1935 Bicknell's thrushes returned to their breeding grounds on Mt. Mansfield between May 26 and 31 and that the peak of their arrival was between the 28th and 31st. In other years they may undoubtedly return earlier, if spring is earlier, but probably (judging from migration data) rarely before the 20th, and usually not before the 25th.

## General Habits and Impressions

Some of the specific and racial traits of these thrushes have been alluded to in previous paragraphs; a few additional considerations may serve a useful preliminary purpose here. Ordinarily in their summer haunts, only fleeting glimpses are caught of a brownish olive form slipping quickly from view into concealment. Sometimes they may be observed feeding quietly on the ground, or perched upon a balsam spire at dusk, calling and singing. If molested near their young, as frequently happens in July, they may abandon their usual wariness and boldly approach an intruder with harsh cries of alarm. Wary, cautious, and exceedingly alert, and inhabiting as they do only the most isolated and inaccessible areas, they have been aptly termed one of the shyest, rarest, and least known of North American land birds. A few quotations from other observers, rather than revealing any valuable information on actual habits, for the most part only heighten the general impression of their shyness and the difficulties of observing them.

Brewster (1883), on a quest for this bird on Mt. Washington, wrote that it was a "much shyer, noisier, and more restless bird than the Olive-back" and that he found it next to impossible to creep within shot of one, for long before he was near enough the wary bird would take flight. "Indeed the two specimens taken were only secured by snap shots directed almost at random toward some opening in the branches

where the flash of a wing betrayed its owner's movements." In another article (Brewster, 1895) he remarks

> . . . one may spend hours within their chosen haunts without getting a fair view of a single individual, for . . . Bicknell's thrush is, while breeding, one of the shyest of our smaller birds. As the intruder advances, forcing his way with difficulty through the matted evergreens and stepping with necessary caution to avoid the many hidden holes and crevices among the moss-covered rocks, the birds, which have been singing or calling on every side, become silent, and elude observation so cleverly that often not one of them can be found.

Howell (1901), referring to experiences on Mt. Mansfield, wrote

> During the seven trips I made to the summit, I was constantly on the alert for a sight of the birds, and although I frequently heard them all about me, so shy were they that I saw them probably less than a dozen times. The glimpses I had of them were either at long range or cut short by the sudden departure of the bird into the dense cover of the evergreens, so that close study of their habits was impossible.

Still others have experienced the misfortune of planning a special trip to the mountain in quest of this elusive bird and then not finding it (Whittle, 1920), probably because the birds' period of song, the time when they are most likely to be noticed, is so short.

But on the other hand a few observers have found Bicknell's thrushes abundant and tame. Langille (1884), reported them "abundant, and not particularly shy, for a Thrush," thus affording him "ample opportunity for the study of its habits."

Bent (unpublished) also wrote of the Seal Island birds:

> They were not at all shy and even seemed to be quite friendly, as they would fly right up to me and sit on a low branch, within 15 or 20 feet, and talk to me. . . . In the spruce woods at the south end, Bicknell's Thrushes were exceedingly abundant everywhere; their call notes were heard almost constantly. They did not seem to have the slightest fear of man, or else their curiosity overcame it, for, as soon as I entered their domain, I would hear their soft whistles and catch a glimpse of a shadowy form flitting past me, or see a trim, grayish bird sitting on a

> branch near me, cocking its head from side to side, as it looked me over. Its call notes would soon be answered by several of its companions until, perhaps, half a dozen of the graceful birds were within sight, moving about by short flights, usually near the ground or among the lower branches. After a few minutes, having satisfied their curiosity, their calling and scolding notes would cease, and they would gradually disperse; perhaps I would not see them again for a long time.

Bradford Torrey (1889, 1896), on Mt. Mansfield at a time when nesting cares were just completed, found them abundant and noisy, "almost a nuisance," and, "never out of hearing and seldom long out of sight, even from the door step." But "bicknellian" enthusiasts who have attempted to take advantage of this weak period in the bird's behavior in order to get on more familiar terms with them have been sadly disappointed. Though Mrs. Davenport (1903) mentions their emerging from cover to feed about the yard after the young are fledged, in general Torrey's experience has seldom been duplicated, either in New England or in other parts of the bird's range, except possibly Seal Island, which in so many respects has presented unusual circumstances.

My own experience may be briefly summarized by suggesting that while ordinarily they are wary and easily alarmed, and during certain parts of the breeding season almost impossible to find, there are numerous occasions when they may become either bold or inquisitive. This is often correlated with the nesting cycle and may be partly related to sex, since the female has nearly always proved to be tame and fearless at the nest. The male, then, always more or less wary and suspicious, is difficult to approach, and the female, though unsuspicious if encountered by chance, is seldom seen while nesting. Possibly it is the latter that are found feeding fearlessly about cabins after the nesting cares are over. But molting follows soon after nesting and at that time no thrushes are likely to be seen. These and other impressions can be more properly developed in connection with nesting activities.

## Food Habits

### *General Methods of Feeding*

In their general feeding activities thrushes of this form are very versatile, effectively combining methods employed by other groups of pas-

serine birds. Sometimes they feed among the trees, leisurely hopping from branch to branch like a vireo, or flitting restlessly among the leafy twigs like a warbler. They perform some fly-catching on the wing, by launching from a lookout perch in the manner of true flycatchers.

The major part of their bill of fare, however, is obtained on or near the ground, where they may be seen hopping briskly about beneath the trees or among low branches, picking up miscellaneous items as they go. They progress by swift hops or short flights, often pausing to look and listen, cocking their head first to one side then the other, peering about in all directions for possible insect prey. It is a pretty sight to see one halt beneath a leafy branch or tall fern, peer up into the foliage, then give a quick leap, pulling down a hapless insect with a sharp snap of the beak. They appear to be the most active and restless of our sylvan thrushes, and feed with great rapidity.

### *Stomach Analyses*

Since stomach contents afford the best criterion for judging food tendencies, it is very fortunate that expert analysis of a few stomachs of these birds has been made.

F. E. L. Beal (1915) has examined 111 stomachs of thrushes of the gray-cheeked group. Apparently all but three (which fortunately happened to be Bicknell's from Mt. Mansfield) were migrant specimens, probably mainly the larger form. Inasmuch as the feeding habits of all gray-cheeks are probably similar while migrating, the results of Beal's examination should be an accurate index to the food habits of Bicknell's thrushes during migration.

Table X summarizes the results of the examination. Their predilection for animal food even during migration is at once apparent. This amounted to 74.86 per cent, the highest percentage of animal food known for any *Hylocichlae*. Beetles constituted about 33.32 per cent of the total food, including 2.83 per cent of beneficial ground beetles. Ants were eaten regularly, as were caterpillars, and spiders. Vegetable matter amounted to 25.14 per cent and was practically all wild fruits of 18 different species.

TABLE X

*Summary of Food Items in Stomachs of 111 Gray-Cheeked Thrushes*

| ANIMAL | PER CENT | VEGETABLE | PER CENT |
|---|---|---|---|
| Coleoptera (beetles) | 33.32* | Wild fruit | 23.98 |
| Formicidae (ants) | 16.34 | Rubus seeds | 0.15 |
| Lepidoptera (caterpillars) | 8.81 | Other vegetable | |
| Arachnida (spiders) | 5.77 | matter | 1.01 |
| Hymenoptera (except ants) | 5.60 | | |
| Orthoptera (grasshoppers) | 1.72 | | |
| Misc. insects (flies, bugs, etc.) | 2.89 | | |
| Crawfish, Sowbugs, Angleworms | 0.41 | | |
| Total Animal | 74.86% | Vegetable | 25.14% |

*Includes 2.83 per cent useful carabids.

> Thus Beal concludes that most of the animal food is composed of either harmful or neutral elements. The vegetable food, drawn entirely from nature's storehouse, contains no product of human industry, either of grain or fruit. Whatever the sentimental reasons for protecting this bird, the economic ones are equally valid.

During the breeding season Bicknell's thrush, at least, is even more addicted to insectivorous tendencies, for the percentage of animal matter in the stomachs examined was practically 100 per cent. Table XI is based on F. E. L. Beal's examination of five stomachs from specimens taken on the breeding grounds from June 22 to July 2, three of which were from Mt. Mansfield. Their proclivity for ants is immediately evident, such items often comprising half or nearly half of the entire stomach contents. The table is arranged from data supplied by W. L. McAtee of the Biological Survey.

TABLE XI

*Stomach Analyses of Five Bicknell's Thrushes*

| ITEM — LOCALITY: | MT. MANSFIELD, VT. | | | SLIDE MT., N. Y. | | AVERAGE |
|---|---|---|---|---|---|---|
| SPECIMEN: | #11 | #12 | #34288 | #4257 | #4258 | |
| Formicidae | 50% | 55% | 5% | 42% | 46% | 39.6% |
| Chrysomelidae | 3 | .. | 90 | .. | .. | 18.6 |
| Lepidoptera larvae | 10 | .. | .. | 13 | 20 | 8.6 |
| Elateridae | 8 | .. | 5 | .. | 25 | 7.6 |
| Cerambycidae | .. | .. | .. | 35 | .. | 7.0 |
| Tipulidae | 12 | 20 | .. | .. | .. | 6.4 |
| Carabidae | .. | 10 | .. | .. | 5 | 3.0 |
| Hymenoptera (ex. ants) | 2 | 10 | .. | .. | .. | 2.4 |
| *Homorus undulatus* | .. | .. | .. | 10 | .. | 2.0 |
| Staphylinidae | 7 | .. | .. | .. | .. | 1.4 |
| Ephemerida | 7 | .. | .. | .. | .. | 1.4 |
| Misc. Coleoptera | .. | 5 | .. | .. | .. | 1.0 |
| Weevils | .. | .. | .. | .. | 3 | 0.6 |
| Lampyridae | 1 | .. | .. | .. | .. | 0.2 |
| Diptera | .. | .. | .. | .. | 1 | 0.2 |
| | 100% | 100% | 100% | 100% | 100% | 100% |

Examiner: F. E. L. Beal; collectors: A. H. Howell and J. A. Weber

Table XII, based on the stomach examinations of two specimens taken on Mansfield, June 21, 1933, and examined by Clarence Cottam, shows too miscellaneous and variable a list of items for a simple tabulation.

In late summer and during the autumn migration these thrushes become partly frugivorous, taking considerable quantities of berries. Brewster (1906) writes that in autumn they subsist largely on berries—cornels, deadly nightshade, barberry, spice-bush, wild grape, woodbine and poison ivy. Burns (1913) reports collecting a specimen of *bicknelli* at Berwyn, Pennsylvania, on October 6, "while feeding on pokeberries." Loomis (1894), speaking of gray-cheeks, says they "feed exclusively on dogwood berries" while passing through Chester, South Carolina.

Nevertheless their predilection for animal food is probably never lost, even in autumn, and what fruit they take seems more or less incidental to their habitual animal diet. Experience with two caged birds, though not an accurate criterion as to what thrushes eat in nature, at least shows

TABLE XII

*Stomach Analyses of Two Bicknell's Thrushes*

#6089 Mt. Mansfield, Vt.; June 21, 1933; Howell and Burleigh

Condition of stomach: very full

Percentage of animal matter, 100; of vegetable, trace, of gravel, etc., —

Contents: Frag. of 1 Miridae, trace; frag. of 3 Cicadellidae, 1%; frag. of undet. Homoptera, trace; frag. of 10 or more Rhyacophilidae, part of which were ?*Rhyacophila* sp., 10%; frag. of undet. Trichoptera, 7%; frag. of Neuroptera, 7%; frag. of 1 Scolytidae, 1%; frag. of 1 Staphylinidae, trace; frag. of undet. Coleoptera, trace; frag. of 2 *Hydrotaea* sp., 2%; frag. of 4 *Helina* sp., 3%; frag. of 2 *Sciara* sp., 2%; frag. of 5 or more Hylemyia, 5%; frag. of 10 or more Empididae, 5%; frag. of 3 Calliphoridae, 8%; frag. of 1 *Dilophus* sp., 1%; frag. of 1 *Hebecnema* sp., 2%; frag. of 4 undet. Anthomyiidae, 8%; frag. of 2 or more *Eristalis* sp., 8%; frag. of 2 *Melanostoma* sp., 6%; frag. of undet. Syrphidae, 6%; frag. of 1 Borboridae, 3%; frag. of undet. Diptera, 6%; frag. of undet. Sphecoidea, 2%; frag. of Crabronidae, 1%; frag. of 1 Figitinae, 1%; frag. of 1 Pseninae, 1%; frag. of Ichneumonidae, 2%; frag. of Lepidoptera, 1%; frag. of undet. Insecta, 1%; frag. of spider, trace; vegetable fiber, trace.

#6090 Mt. Mansfield, Vt.; June 21, 1933; Howell and Burleigh

Condition of stomach: full

Percentage of animal matter, 97; of vegetable, 3; of gravel, etc., —

Contents: Frag. of Cicadellidae, 1%; frag. of undet. Homoptera, trace; 5 larvae of *Limonius* sp., 18%; frag. of 8 Carabidae, of which 2 were *Notiophilus* sp. and 1 was *Cryobius* sp., 24%; frag. of 2 *Cytilus alternatus*, 5%; frag. of 2 Staphylinidae, 2%; frag. of 1 Elateridae, 2%; frag. of 3 Chrysomelidae, 5%; frag. of undet. Coleoptera, 4%; frag. of Trichoptera, 10%; frag. of Neuroptera, 4%; frag. of *Camponotus* sp., 3%; frag. of Formicidae, 1%; frag. of undet. Hymenoptera, 4%; frag. of Syrphidae, 4%; frag. of undet. Diptera, 3%; frag. of Phalangiidae, 7%; conifer frag. and plant fiber, 3%.

Examination made: by Clarence Cottam
August 24, 1933

certain food preferences. These birds ate considerable quantities of the berries native to Mt. Mansfield — blueberries, bunchberries, snowberries, red-berried elder and twisted stalk—but they never could be induced to subsist entirely, or even largely, upon them, even for a short time. With their cage well supplied with berries they would clamor for insects and eat them greedily when brought. This fall and winter the surviving bird has lived chiefly on animal food (fresh meat) flavored, now and then, with fruit. This presumably indicates that berries and fruits, which really

may be consumed in surprising quantities at times, play only a secondary role in the Bicknell's diet, serving merely to supplement items of an animal nature.

An unexpected taste, discovered as a result of rearing a caged bird, is an apparently natural desire for something leafy, two young thrushes in captivity taking greedily to fresh lettuce. Stomach analyses did not show this fact, as leafy items, if present at all, are quickly passed, thus escaping detection. One breeding bird out of the six examined by the Survey had 3 per cent of vegetable matter in its stomach, the others only traces. Stomachs examined by the writer usually included a balsam needle or two, presumably taken accidentally while feeding. Possibly leafy matter may play a more important part in a bird's natural diet than commonly supposed. The caged bird has been kept in good condition on a seemingly well balanced diet of fresh meat (to replace insects), lettuce and fresh fruit. The lettuce seems to provide the bulky matter necessary for proper elimination.

Field observations on food habits are principally related to nesting studies, and will be more fully considered under that head.

### *Economic Importance*

The foregoing evidence relating to food habits of these thrushes clearly indicates their tendencies to prey almost solely upon injurious insects. In view of their limited occurrence during migration, however, the role they play in checking the breeding potential of destructive insects is probably relatively insignificant; and in their summer home they are so isolated from all aspects of what we call civilization that they never come in contact with the more common agricultural pests. But in the mountainous solitudes of their native haunts, where, though over a limited area, they are truly abundant, the part they play in nature's great scheme must be an important one. For on the mountain top, as in the valleys, the balance of nature exists, and in the continual war to check insect supremacy in this bleak ecological niche, Bicknell's thrushes are among the principal actors. The firs are constantly being riddled by tree borers (*Monohammus notatus*); grasshoppers (*Melanoplus*) occur in swarms in the blueberry patches; and in 1935 larvæ of a saw fly (*Neurotoma fasciata?*) actually defoliated all the mountain ash in the vicinity in spite of thrushes.

## Song and Call Notes

### *General Considerations*

Among the world's most celebrated and accomplished songsters, our North American hylocichlid thrushes have always occupied a position of high renown. Though the classical popularity of the nightingale and other European singers, so highly extolled in song and verse, has to some extent shadowed the equally remarkable performances of our sylvan thrushes, many ornithologists who have had the opportunity of listening to both are partial to one or another of our *Hylocichlæ*. Bird lovers may differ widely in their choice, but the hermit thrush has undeniably been the most frequent favorite. The late discovery of a new thrush inhabiting the mountainous portions of northeastern United States opened the way for investigations concerning an additional song.

The songs of our wood-inhabiting thrushes appear to be divisible into two distinctly different types — the slow, leisurely outpouring of separated phrases of greatly variable pitch, such as are characteristic of the wood and hermit thrushes; and the more continuous, slurred, chiming notes of more or less unvarying pitch typified by the veery and gray-cheeked group. The olive-back seems to be a connecting link between the two groups, but to my ear is much nearer the former. The Bicknell's song, by common consent, is of the veery type, distinguished from it chiefly by the characteristic break occurring a little past the middle of the song.

### *Qualitative Status of the Song*

From the qualitative standpoint the Bicknell's song has been considered somewhat inferior for a thrush. Relegation of this bird to an inferior place is partly due to the fact that the veery type of singing is not as popular as that of the wood and hermit thrush. Some ornithologists, however, including Ridgway, have shown a decided preference for the veery type. Though I once liked the wild and fascinating refrain of the veery and Bicknell's best, in subsequent years, with ample opportunity to listen to hermits, Bicknell's, and olive-backs singing simultaneously day after day, have come to the conclusion that nothing I have heard can quite equal the serenely exalted music of the gifted hermit, and that even the olive-back puts more pure melody in his song than does Bicknell's thrush. And yet in the song of the latter there is a mysterious fascination, perhaps not actually associated with musical qualities, that none

of the others, except the veery, possess. It is in perfect keeping with the wilderness solitudes which they inhabit.

*Character of the Song*

Practically every ornithologist who has visited the breeding haunts of this thrush has commented on its song, partly no doubt because a major incentive in attempting to reach its summer home has been to hear this new form, partly because, with a bird so seclusive, little else could be observed. Many articles dealing with these birds on their breeding grounds boil down to mere descriptive impressions of their song and call notes. Numerous locality records, some reliable, some obviously not, have been published solely on the basis of birds heard but not seen.

Though it is impractical to review all the literature pertaining to the singing of this form, a judicious selection of citations will serve the double purpose of showing what has already been written, and illustrating the character of the song. Critical comments on the accuracy of the quoted description may serve a useful purpose.

The first mention of song appropriately comes from the pen of this bird's discoverer, E. P. Bicknell (1882). In his early paper, however, he devoted his attention primarily to relationships, merely remarking the distinct difference between the song of this new thrush and the olive-back, with which it had long been confused. He noted its subdued tones, its ventriloquous nature, and its similarity to the veery.

The earliest detailed description of the song of Bicknell's thrush (Brewster, 1883) introduces an unfortunate and complicated state of affairs, for Brewster's excursion into the White Mountains resulted in the following erroneous description:

> The song of Bicknell's Thrush is exceedingly like that of Swainson's; indeed, to my ear, the usual strain, though rather feebler, was nearly indistinguishable; but occasionally — perhaps on the average once in the course of five or six repetitions — a peculiar, and apparently perfectly characteristic bar was interpolated. This was a flute-like *per — pseueo-pseueo* given quickly and in a tone which, at a little distance, closely resembled that of the Solitary Vireo's well-known voice.

It has been my experience that as late in the summer as July 19 or 20, when Brewster heard this song, few if any Bicknell's would be singing, although olive-backs would. Considering the season, then, and the char-

acter of the description, there can be little doubt that F. H. Allen (1930) is right in maintaining, on Torrey's verbal testimony, that the song heard and described by Brewster was actually an olive-back singing a slightly unusual strain, — a fact which Brewster later admitted to be true, but unfortunately never acknowledged in print. Though he let the old erroneous description stand, he virtually corrected himself, when, in a later article (Brewster, 1895), after becoming better acquainted with Bicknell's thrush, he published a new and more accurate description:

> The song is exceeding like that of the Veery, having the same ringing, flute-like quality; but it is more interrupted, and it ends differently, — the next to the last note dropping a half tone, and the final one rising abruptly and having a sharp emphasis.

Brewster's early error received additional emphasis when Forbush (1929), who had never heard the Bicknell's song, quoted both of Brewster's descriptions with the remark that the song must indeed be quite variable if it resembled both the olive-back and the veery, which to his ear had little in common. It is indeed unfortunate, as Allen has pointed out, that this "error of observation made by the greatest field ornithologist New England has ever had" is "perpetuated by the author of a book that will long stand as a great compendium of New England ornithology."

Rev. J. H. Langille (1884), whose fluent pen has given us so many delightful bird descriptions, writes of the song of the Seal Islanders as follows:

> The song *tsiderea, tsiderea, tsiderea,* sometimes *tsiderea, rea, tsiderea,* or some other modulation of the same theme, is similar in tone to that of the Wilson's Thrush, but more slender and wiry, and therefore not nearly so grand and musical. In the solitude of the evergreen islands, however, it is by no means an inferior song, the sibilant strokes of the voice being finely relieved by the more prolonged liquid vibrations.

A. C. Bent (unpublished field notes) visiting Seal Island July 3 to 6 1904 gives a similar characterization of their song.

> Their most striking song was quite vivacious and emphatic, *chipper-che-wea, chipper-che-wea, chipper-wea-wea.* They also had a loud musical whistling song, *wheeto, wheeto, wheeto.* After writing these down I realize how futile words are to describe the

> beauty of those thrushes' songs; they must be heard in all their native, wild surroundings, where the long, pointed tops of the picturesque spruces are sharply painted on the crimson sky of the northern sunset, and where the rich dark greens of the coniferous forest are broken only by the deep blue beds of wild iris that fill all the open spaces along the old road.

Neither Langille's nor Bent's syllabic representation appears to fit very well the Mt. Mansfield song. It would indeed be interesting to know if this Seal Island colony of thrushes actually sings a different song, and if so, why.

Faxon (1889), doubtless recalling Brewster's early description (later correct description not published till 1895), reports the song in the Berkshires as similar to the veery, not the Swainson's.

> It is introduced by two or three low chucks only to be heard at a short distance . . . like those that precede the song of the Whip-poor-will.

Since these preliminary, plucking notes are a regular, almost invariable, feature of the song it seems rather surprising that of all the observers reporting on the singing of this form only Faxon (and recently Gillet) mentions them.

Torrey (1896) gives a pleasing picture of the song of this bird in its summer home on Mt. Mansfield.

I stood in the piazza while they sang in full chorus.

> At least six of them were in tune at once. *Wee-o, wee-o, wee-o, tit-ti wee-o* — something like this the music ran, with many variations; a most ethereal sound, at the very top of the scale, but faint and sweet; quite in tune also with my mood, for I had just come in from gazing long at the sunset, with Lake Champlain like a sea of gold for perhaps a hundred miles, and a stretch of the St. Lawrence showing far away in the north.

Howell (1901) gives a similar syllable representation of the song together with some valuable remarks concerning the general character of the notes.

> The song is quite unlike any of the other Thrush songs, resembling the Veery's somewhat in form, though not in quality of

> tone, which is like that of a fine high-pitched reed. It is not so loud, or so clear as either the Olive-back's or Veery's, and unlike the former does not change its pitch perceptibly. The syllables *wee-a-wee-a wee-chi-chi-wee*, whistled through closed teeth, will give a faint conception of its character. The opening notes, *wee-a*, repeated two or three times, are smooth and flowing and are followed by two staccato notes; the closing note resembles the opening ones, and is without special emphasis. The last three notes taken together form the characteristic portion of the song, and are frequently given by themselves without the prelude.

Howell's description of the song of Mt. Mansfield thrushes seems to me the best and most accurate one yet written, but this of course may be partially due to the fact that I have studied the birds in the same region.

Mrs. Davenport (1903), visiting the same region two summers later, quotes Howell's description, adding that she heard it usually given as "*wee a wee a we we* then the *chi chi*, the last thin and high, but with the vibrant quality of the Wilson without change of pitch, closing with *wea wea*." This representation differs from the preceding simply by the addition of an extra opening syllable, sometimes inserted.

Hoffman (1904) writes the song of the Mt. Mansfield birds "*tee-dee-dee-a tee-dee-ee*, with a slurring effect on all the long syllables."

Childs (1905) gives a charming little account of a special trip taken to Mt. Adams, New Hampshire, for the purpose of hearing this "rare and little-known species." The account is appropriately entitled "A Night Among the Clouds with Bicknell's Thrush."

> Here, for the first time I heard the wiry, high-pitched song of Bicknell's Thrush, not unlike that of the Wilson's Thrush in many respects, yet less loud and melodious, thinner and sharper, with a charm all its own that was a delight to listen to. We camped here for the night and listened to the song of this bird, I came so far to see and hear, until after dark. It was fully nine o'clock before the last one stopped singing.

Apparently Mr. Childs, whose home was in Floral Park, New York, must have been well along in years at the time of this trip, for he adds:

> I left the breeding grounds, among the clouds, of Bicknell's Thrush most reluctantly, as I felt I should never again hear the song of this delightful bird, as it is not likely that I shall again attempt to reach its summer home.

Sweet (1906) in an account of a trip to Mt. Abraham, Maine, gives a short description of the song, though no birds were seen.

> *Tsee, tse, vree-e-e-e-e-e,* commencing with two short, low, sibilant notes, followed by a prolonged note of blended alto and soprano. Richer and more musical than the Veery song.

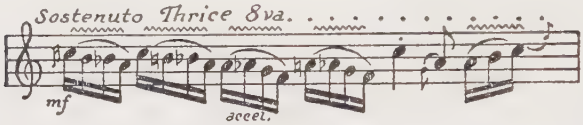
This is apparently an accurate account of Bicknell's song, the "prolonged note," into which the author has merged both the accented and unaccented portions, being the characteristic part of the song.

Whittle (1920), unable to find any Bicknell's on Mansfield in 1918, returned the following year and gave an interesting account of these birds in their native solitude.

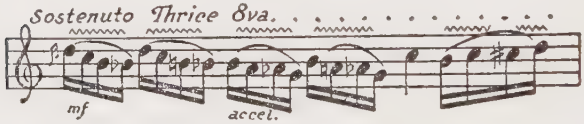
> The quality of voice suggested that of the Veery, but the song was slower, richer, and wholly lacked the Veery's downward spiralling. . . . Here and there the expanse of balsams was punctuated with Bicknell's Thrushes, each perched on or near the tip of a balsam spire. With all of Vermont and much of its neighboring states spread beneath their gaze, they lifted their heads and voices and sang their little, captivating, haunting song of three to six notes, all the notes, except one being long and slurred. They put so much music and time into each note, that the song, even in its three-note form, was still wonderful, and one never heard enough . . . the tender cadences of Bicknell's seemed to indicate, *oh, sweet, dear Vere de Vere,* each note vibrating and liquid. The shorter forms were, *oh, dear Vere de Vere,* or simply *Vere de Vere.* There is little range of tone.

Mathews (1921) has dealt at some length with musical aspects of the Bicknell's song, which he has apparently studied on Mt. Mansfield and in the White Mountains. His practice of using musical notations to represent bird songs may not meet the approval of all ornithologists, but it at least gives an opportunity to study the inner, detailed, notational composition of "bicknellian" melody.

The same effect of a "silvery spiral thread of music" obtains in this bird's song as it does in the Veery's, the same vague, mysterious descent of three or four mixed tones but with the addition of a distinctly solitary one — or perhaps two — and a final uprising mixed tone. These two records obtained on Mt. Mansfield, Vermont, close to the Summit House, under the "Nose" and in the very midst of the breeding grounds of Bicknell Thrushes show no very marked differences in structure:




From Mt. Mansfield. Vt.




The high c is the final c of the piano, and a practiced and musical ear will detect an initial tone in some songs even higher. But the actual pitch of the song is less important than its final accent of the scale, that is unique!*

Though admittedly I am not in a position to evaluate Mathews' notations from the technical standpoint, they do not agree with my observations in all details. Each group of notes is represented as slurring downward to the same extent as in the veery, which to my ear does not hold true. He gives four phrases before the break, though three seems to be the more usual number; but admittedly they are merged to such an extent that a well trained musical ear might be able to separate out an additional one. I have never been able to detect the final, supposedly characteristic ascent of the scale of which Brewster, Mathews and others speak. The rise actually comes earlier in the song and the final notes seem to fade away weakly without any perceptible ascent.

Unfortunately Aretas Saunders has not been sufficiently familiar with these birds to give them adequate space in his admirable and popular

*Notations and description copied by permission of the author.

works on song. His first publication (1929) omits this form, and his recent book (1935) treats of the gray-cheek group as a whole. He has heard the song of the smaller form in the Adirondacks, however, and speaks of it as follows (Saunders, 1929):

> The song suggests both the Veery and the Olive-back and even to some extent the Hermit. I have heard too little of it to write conclusively, but birds about Mt. McIntyre on two or three occasions sang songs that progressed upwards in pitch as does that of the Olive-back, though the single phrases slurred downwards in groups of three notes, and were accompanied by *r*-like sounds suggesting the Veery. I wrote the song 'raylio-rilio-reelio-reelio.' The change in pitch is not so great as in the case of the Olive-back.

Gillet (1935) has been making an especially elaborate study of the songs of our thrushes and has devoted considerable attention to Bicknell's in the Catskills, White Mountains, and the Gulf of St. Lawrence region, later continuing his study on Mt. Mansfield. Though he has spared no pains to be scientifically accurate, his primary purpose has been a purely literary and appreciative treatment of the subject. As a result we have an exceedingly colorful description that is based wholly on persistent observation. Space prohibits a full review of his comments on the singing of Bicknell's thrush, but the paragraph dealing particularly with the structural character of the song may well be quoted.

> The Bicknell's song differs from the songs of all the other thrushes except the gray-cheeked in low-voicedness and diminished carrying power. . . . The mist-haunted heights seem to have reduced it to a whispered thinness of tone. The song is quite different in effect according as it is heard at close range or from a distance. This is due largely to the two distinct parts into which it divides. The most striking characteristic of the song is its abrupt turn midway. The first part is a series of spiralling chimes which, though on muted strings as it were, suggest the veery's chant — gyrating, rich in reverberating resonance, wild, with just enough variation from singer to singer to puzzle one to make out whether the spirals ascend or not, though in combination with the second part, that is their effect; the song then skips or cascades over, . . . into a second part

> quite different. This second part is louder, a clear-cut couplet of rising and falling notes by which the Bicknell's song can be identified. Heard at a little distance, the first part of the song has a swinging movement, *sweo-ter-see*, a sweetly intertoned tintinnabulation of fairy bells; the second part comes out forcibly, is simple in sound, penetrating, and held at the end, '*ter-ree.*' It is the second part that you hear farthest — that alone you catch in the firry scrub below as you walk the high bald ridges, or far up the mountain side as you silently paddle the lake just before dark. The chief varieties in the song come about through increase in the number of introductory spirals which make it more like a veery, and through a difference in the tone and quality of the closing cadence.

It may well be added, out of justice to Mr. Gillet, that since contributing the article from which this description is taken, he has continued his studies of Bicknell's song and believes that the description can be amended and improved in a number of respects.

This series of citations may appropriately be concluded with the brief, simple, yet vividly glowing characterization from the pen of that venerable naturalist John Burroughs, who on hearing the song of the bird in the Catskills wrote of it (Burroughs 1895):

> The song is in a minor key, finer, more attenuated, and more under the breath than that of any other Thrush. It seemed as if the bird was blowing in a delicate, slender, golden tube, so fine and yet so flute-like and resonant the song appeared. At times it was like a musical whisper of great sweetness and power . . .
>
> Mr. Bicknell's Thrush struck up again at the first signs of dawn, notwithstanding the cold. I could hear his penetrating and melodious whisper as I lay buried beneath the boughs.

Letting these quotations replace further discussion of the song, its principal features may be summarized at this point. The song is introduced by two or three, usually two, low plucking notes, *chook-chook*, audible only at close range. These preliminary grace notes are hurriedly followed by two to four, usually three, high-pitched, vibrant, ringing phrases that slur downward, similar to but less marked than in the so-called "intertwining circles" of the veery that so suggest chiming.

Usually on the third, but sometimes on the second or fourth, of these phrases, there is an emphatic break which is accompanied by both rise in pitch and increased intensity. This break comes a little past the middle of the song and is the peculiar feature that distinguishes the Bicknell's song from those of the veery and other members of the gray-cheek group. This climax phrase, consisting of several merged notes, is held for an instant, then runs imperceptibly into the closing notes, which are unemphasized. The final phrase seems to fade away as if in the ensuing silence there might be additional whispered notes which the human ear is not attuned to catch. The refrain is often repeated over and over, the singer seeming to hurry through in order to begin again. My early impression was that these final notes dropped in pitch, but aware that other observers (with perhaps better ears for music) insist on a rise at precisely this finale, special attention has been given to the closing notes. These now seem to me to maintain the level of the original pitch without lowering, and even rarely to rise slightly; but they are always thin, weak, and unaccented. Not infrequently the song is begun by uttering the opening phrases, but dropped without completion, as a white-throat breaks off whistling; and conversely, as already observed, the final part is often given without the prelude, though in many cases this omission is apparent rather than actual, the prelude simply not being audible.

The complete song, then, may be (inadequately) represented as *chook-chook, wee-o, wee-o, wee-o-ti-t-ter-ee.* This can be approximated by whistling through closed teeth, but the syllables are hard to distinguish, the many intertwining reverberations merging the notes inseparably. Mathews suggests long and short vocal chords vibrating simultaneously to account for the singular harmony and overtones characteristic of thrush melody.

On rare occasions a totaly different song was heard, possibly the three- or four-syllable song other observers have referred to. At the time, I wrote it as "che-che-che-che," and could not decide where the accent, if any, lay.

### *Flight Song*

Discussion of the subject of song would be wholly inadequate without considering one singularly remarkable feature that seems to have escaped previous published observations — that of an elaborate flight song found to be characteristic of these birds. Singing on the wing is not

merely an occasional practice indulged in at rare intervals, as in the case of some flight singers, but is a regular twilight performance during practically the whole season of song. It seems so vital a part of their mysterious evening activities that it is difficult to think of nuptial completion without the flight ceremonies.

A new book, *Birds of America* (1936), alludes to an observation by John Burroughs of an Alaskan gray-cheek that "hovered in the air fifty feet or more above the moor and repeated its song three times very rapidly." Otherwise this unique habit has not been reported among thrushes of this genus, and though it may possibly be true of the veery, it would hardly be expected among such composed songsters as the wood and hermit thrushes. It appears not to be true of the more restless olive-back. If, then, it is a habit peculiar to the Bicknell's thrush and its close relatives, the question of the origin of this flight singing becomes an intriguing one. At best it seems a remarkable and unexpected performance.

Singing on the wing was first noticed on Mt. Mansfield, July 5, 1933, when in the dim twilight an unseen singer suddenly rose from the firry scrub on the side of the Adams Apple and flew down to the brook-bed south of Taft Lodge, nearly a quarter of a mile, singing as it flew. The bird flew rapidly, uttering three complete songs in its straight-line course, so that the progress of its flight could be traced farther and farther into the distance by listening to the singing notes. The song was, and typically is, in all respects identical with the ordinary perching song except that it appears to be more hurriedly and breathlessly delivered. In this instance the song could have had but little bearing on territorial relationships, since the flight crossed several such areas and occurred at the time of dissolution of territorial bonds, when these birds break out into a short, mid-seasonal relapse of song. But during the study of a belated nest on July 11, that same season, a flight singer, presumably the nesting male, circled over the territory in full song. Though these observations came toward the close of the Bicknell's period of song, flight singing appeared not to be uncommon during the remainder of the season.

Arriving early on the breeding grounds in 1935, I found much more favorable opportunity for observing flight singing. On the evening of May 31, which seemed to be the first evening of full-throated singing, the thrushes were very numerous and active. My field notes for that night read: "Especially as it grew darker they flew from place to place, singing as they flew. Shadowy forms in song flitted past, sometimes more than one singing in the air at once." And on a subsequent evening:

"Bicknell's struck up in flight song at 8:21 P.M., and sang thick and fast for ten minutes, mostly in flight. I could see their shadowy forms drifting along in zigzag flight, alighting momentarily on trees and then taking wing again." Three or more were often singing simultaneously in flight over a small area, their wild, chiming notes mingling in a grand musical concert. Though some appeared to be attached to definite areas to which they usually returned on completion of their flight, still others assumed the role of wanderers, roving from place to place. Even if some were attached to a given ground area, the air seemed to hold no boundaries, and the number of singers present was inconstant due to free wandering. They appear to be great visitors. One came up from a ledge an eighth of a mile below, singing as he came, and, after paying his respects to the area, flew back again, singing as he departed.

Sometimes the musicians soar to considerable heights, a hundred or more feet from the ground; but more often they merely fly from one station to another or hover in circles over a given grove to which they repeatedly return. Flight songs may alternate with singing from perches.

Flight singing is spread to some extent over the whole season of song, but reaches its maximum development in early June before incubation is begun. This suggests a primarily prenuptial function. It is confined to the twilight following sunset or preceding sunrise, and lasts for only ten or fifteen minutes, culminating about one-half hour after sunset, when the western sky is still aglow with lingering light, but the woods dim with shadows. Increasing darkness puts an end to all singing. Flight singing is of less frequent occurrence in the morning, as Bicknell's are rather fitful morning singers at best.

### *Daily Cycle of Song*

During the pre-nesting period in early June, Bicknell's thrushes may sing at any hour of the day, from before dawn till after dark; but daily peaks of intensity occur. On Mt. Mansfield they start singing before 3:00 A.M., but of course initiation of song is correlated with the approaching dawn rather than the hour of day. The morning peak of song, coming shortly before sunrise, never equals the evening climax, doubtless because the birds are preoccupied with feeding as soon as it is light enough; and by the time a good meal is secured it is too light for optimum song production. Thus morning singing, although common enough in the early part of the season, is at all times fitful and irregular.

Singing may continue throughout the forenoon, especially on misty

days, but with gradual diminution, until by noon there is hardly a songster to be heard. The early afternoon, which appears to be a period of rest, only rarely produces singing, but by 3:00 or 4:00 P.M. a few birds are likely to start the evening chorus. From then on song increases gradually but irregularly, until, in the period from fifteen minutes to half an hour or more after sunset, the great climax is attained with flight performances as the culminating feature of the daily cycle.

Observations every evening during one spring and two summers indicated that all activities cease quite abruptly at the onset of darkness, which on Mansfield comes at about 8:30 in June. Only at infrequent intervals does a startled singer break out much later than that, although the actual time varies a little with weather conditions, being curtailed during stormy and cloudy weather and prolonged on clear or moonlight nights. Davenport (1903), however, reported them singing on Mansfield till 10:00 P.M. (given as 9:00 P.M. in an unpublished paper by the same author). Childs (1905) on Mt. Adams, N. H., said "It was fully 9 o'clock before the last one stopped singing." Gillet (1935) found the thrushes at La Tabatiere in the Canadian Labrador singing as late as 10:00 P.M., but of course twilight is greatly extended in that northern land. Alaskan gray-cheeks may be heard twenty hours out of every twenty-four (Birds of America, 1936).

Song production varies with weather conditions to such an extent that this mist-loving bird has acquired a well-founded reputation for singing more in damp or rainy weather than on clear, sunshiny days. In fact, the day-time singing of Bicknell's thrush has become indelibly associated in my mind with wisps of cloud floating in and among the balsam spires from which the ringing, ventriloquous voices issue.

### *Seasonal Duration of Song*

In 1935, the first song was heard on May 28, but spring was late that season. Davenport reported one singing feebly as early as the 25th, which is probably nearer the average seasonal initiation of song. From late May until well into the middle of June is the period of maximum production, with gradual diminution until about the fifth of July when a sudden revival occurs, lasting perhaps a week or longer. Then song again dwindles, this time into almost total silence. Midsummer singing, although a very variable feature, is usually of uncommon occurrence.. In 1933 belated songs between the 20th and 30th of July were not particularly rare, but in 1935 this was a period of practically total silence. Then

August follows with postnuptial molts and complete reticence on the part of the thrushes, except perhaps for a fitful outburst. After the 20th of August, however, the long silence of summer gradually terminates, until in early September, with molting completed and pre-migratory movements under way, the woods again become alive with thrushes, their renewed activity not infrequently manifested by snatches of song.

G. M. Allen (1902) heard one singing in Carter Notch, New Hampshire, on September 15. Singing during fall migration has not been reported, but our caged bird has sung almost continually through the fall and winter.

### *Correlation of Song with the Nesting Cycle*

The early June peak of song production is concurrent with mating and courtship activities. Singing continues with unabated fervor for about two weeks, or roughly, till the middle of June, although nest building and egg laying are well under way earlier than that. The obvious decrease in song during the latter part of the month is coincident first with incubation, and later, into early July, with care of the young. Irregularities in singing during late June appear to be due not so much to variations in the starting time of building as to nests having been broken up, since in the latter circumstances the males invariably renew song. In an area where nesting birds are well represented so many nests meet with disaster that some birds are singing at all times during early summer. Moreover, males do sing to some extent during incubation as well as during later stages, but never with the intensity they manifested earlier. Checking the output of song by actual observations on breeding pairs is not as easy as might appear, since the mates of sitting birds do not frequent the immediate nesting site as much as the borderlines of the territory, and such borderline singing cannot be definitely assigned to any particular male. At none of the nests studied did the males sing regularly during the incubation or feeding period, but before the nest was built the prospective site was a favorite area for singing.

The peculiar early July revival of song is concurrent with the cessation of nesting cares when the young are fledged. During the summer of 1935, a large proportion of the nests came to a sudden and disasterous termination in early July with a consequent renewal of song by the males of the unsuccessful pairs. The fact that singing is revived in early July regardless of whether the young are safely fledged or eaten by red squirrels might be taken to indicate that song is correlated with the time of

year rather than with nesting activities, but such a conclusion seems illogical. This midsummer revival of song and its subsequent waning suggests renesting, but much time and effort have been spent looking for second brood nests with indifferent success. Only one nest out of twenty-one was an attempt at a second brood.

It may be concluded, therefore, that intensity of song reaches its culmination during the mating period and continues up to the time of egg laying or later, after which it rapidly wanes. Considerable singing may occur in a prospective nesting site, but as soon as the nest is constructed the male only infrequently sings in its immediate vicinity. Song is renewed when nests are broken up, regardless of the time, and is renewed in early July at the conclusion of the nesting period, regardless of the fate of the young. Thereafter singing lapses into practically complete silence for the remainder of the summer, but fitful snatches of song are not uncommon among pre-migratory gatherings in early September.

*Relation of Song to Sex*

Another surprising fact brought to light by careful attention to nesting birds is the occurrence of singing among the females. This singular habit has been verified now for a small number of passerine birds, but seldom, I believe, in the case of species where the sexes are identical in plumage. Although, unfortunately, this conviction is not substantiated by the infallible evidence that a female collected while singing would furnish, nevertheless there is ample reason to believe that the females can and frequently do sing. At practically every nest under observation the sitting bird was known to sing occasionally during incubation, hatching and brooding. Sitting birds have been watched at all hours of the day and during every stage of the nesting cycle, and incubation and brooding seem to be entirely the work of one bird, without any substitution by the other. That there is not a complete reversal in the behavior of the sexes is indicated by several conclusive lines of evidence. Males have frequently been collected in full song. Incubating females have been taken by various collectors. Nests studied by the writer were too scarce and hard to find to risk collecting the adults to prove this point; but at one nest obviously doomed to failure the bird which I had assumed to be the female was taken, and gonadal examination then verified this belief. Further details regarding these singing females will be taken up in connection with incubation (page 338).

How much, if at all, females sing away from the nest would be a diffi-

cult point to settle conclusively. It would be interesting to know whether they take part in the flight ceremonies, but to collect a swiftly flying bird in the semi-darkness and then recover the specimen from the dense, dark woods into which it would fall seems hardly possible. This, then, is one of the many mysteries these birds are likely to withhold from human knowledge for some time.

### *Call Notes*

The most characteristic call note of Bicknell's thrush is the harsh, penetrating, slurred whistle usually heard as soon as the domains of this bird are invaded. During the noisy season, especially about sundown, every grove on the mountain side resounds with the voices of these birds, as one after another picks up the call note, relaying it from ledge to ledge. Two or more birds situated a hundred yards apart often call back and forth as if answering one another; and if one of them changes the inflection of his call the answering bird does likewise. Although song is often regarded as a purely sexual expression more or less definitely linked with gonadal or hormonal activity, call notes may well be considered a bird's means of communication; and intelligent interpretation of the true meaning of these notes might reveal much about avian sociology.

The most common note and a few of the other calls have been put into various expressive syllables by different observers. Brewster (1883) called it "a single loud, penetrating *queep*, often abbreviated to *quee*, and occasionally varied to *queeah* with a falling inflection." Later (1895) he wrote,

> The ordinary calls are a whistled *pheu* practically identical with that of *T. fuscescens* [really an octave higher], a harsh note which recalls the cry of the Nighthawk, a low *cluck* much like that of the Hermit Thrush, and a *pip* or *peent* similar to that of Swainson's Thrush.

(The latter probably really was an olive-back mistaken for a Bicknell's). Langille (1884) wrote the call as "*cree-o-e-eep*, or *quee-a*, or *cree-e-e-ee*, on a rather high, fine key." Howell (1901) gave it as "a rather harsh *cheep*." Davenport (1903) mentions the "*wheu*" note, "thinner than that of the Wilson," the "*cluck*" note, and the harsh note resembling the cry of the nighthawk. Hoffman (1904) wrote it as "*feé a*, sharp and petulant, often rising to a high strident note suggesting a nasal note of

the Red-winged Blackbird." Saunders (1929) wrote examples as "*eeoh*," "*tseeah*," "*yaoh*," and "*twei*."

The majority of Bicknell's other call notes are merely modifications of the characteristic one, adapted to express a great variety of moods. Although perhaps most often used in its harsh, high-pitched form, which, on occasions such as a disturbance to the young, may truly become of piercing loudness, it is frequently lowered to an inquisitive *pe-irt* that is not unmusical. On a still lower key it may resemble a bluebird-like warble of melodious sweetness. As a preliminary to singing they often call rapidly till the call notes break vibrantly into the song, and then one realizes that the opening phrases of the song are really modifications of the call note with vibrancy, chiming, and harmony added. The *chook-chook* notes are used not only as an introduction to the song, but are also employed by both sexes when alarmed or angry, especially at the nest. A note not mentioned by other observers is a rolling, wren-like, *crr-rr-rr*.

At the nest a great variety of notes are used. The parents have numerous exchange calls and the female chirps and warbles happily to herself while nest building, incubating and brooding. The parental exchange calls and their notes of admonition to the young seem to come the nearest to communication.

### *Acquisition of Song and Call Notes*

Before closing this account of vocal activities it may be well to mention a few observations bearing on the possible inheritance of song and call notes, which is still a moot question requiring additional confirmation from wild birds kept in confinement. Our caged specimen, reared in nearly complete isolation from others of his kind since his 14th day, has gradually acquired all the call notes characteristic of his race, most of which he had never heard before he gave them. Even the habitual call, which he did hear sometimes in late summer on the mountain when he was about a month old, has been best developed since leaving that region. He scolds angrily with the "chook-chook" notes when handled, often accompanying them by vicious snapping of the beak. On rare occasions he uses the wren-like chatter, and has frequently adopted the preliminary plucking notes before his little song. In addition he has acquired many inventive variations of his own, one recent one very suggestive of the baltimore oriole's melodious whistle.

The song, actually started when the young bird was only fifteen days

old, has always been more or less random and experimental, and although resembling the song of the adults in tonal quality, is never broken up into the proper sequence of phrases. He simply trills on in his own captivating little way, often in response to or imitation of other sounds such as running water, steam rushing into a radiator, or even in attempt to follow a radio tune. Whether or not his song crystallizes into the true song of his kind this coming spring will be interesting to learn.* Some of his efforts certainly suggest such a possibility.

This evidence is in general keeping with the belief that call notes are strictly hereditary, but that the song is due to both inheritance and learning by imitation.

### *Mating and Courtship*

Very little is known concerning this important phase in the life-history of Bicknell's thrush. Obviously unpaired during spring migration, they must meet and mate on their breeding grounds in the short period between their arrival and the initiation of nest building, which in the case of early nesters is barely a week. But considering their natural shyness, and the fact that their courtship performances take place under cover, and to a considerable extent in the dim light of evening, it is small wonder that little is known of these mating activities.

Sexual flights have frequently been observed, usually occurring in the early morning or in the evening. The male pursues the female in swift flight, his crest feathers erected, and bill gaping, often breaking into a passionate burst of song as the two dodge swiftly through the thickets. When two birds in close flight both sing, as is not uncommon, it is uncertain whether this is a sexual flight with the female singing, or is merely an instance of one male driving an intruding male from his domains. Only at the nest is it possible to know that the pursued bird is the female; but during incubation the male frequently appears at the nest, driving his mate away for a chase through the groves. Such a sexual flight was once observed in July; and apparently the pair later reared a second brood.

The evening is the great play time of thrushes. As the light of day retreats, these twilight-loving birds emerge from their hidden shelters, soaring in full song across the open spaces or above the woods. Some-

*This young bird, taken back to Mt. Mansfield the following summer, learned to imitate the wild birds with perfection, but usually reverted soon after to his off-tune, winter song.

times they may be seen alighting upon a stump or rock, a perfect picture of alertness, fluttering their wings tremulously as they dance and hop nervously about, perhaps uttering soft whistles or harsh screams. Singly or in pairs, these wild creatures perform mysteries under the cover of semi-darkness that will elude observation for a long time.

Not all these mysterious vesper activities are directly related to mating or courtship, for they continue to some degree throughout the summer; but their obvious concentration during the early part of the breeding season suggests that their major role is in nuptial affairs. The part performed by each sex in these twilight scenes is an open question, but it is pertinent that incubating females always leave their nests at about this time.

Young birds exhibit sex reactions at an early age. When hardly more than a month old our pet would suddenly mount an object — a hand, foot, pencil, or small object on the floor — press his body down close upon it, flutter his wings and open his beak. Though this may be partially a mere playful impulse, to all appearance it looks like a reaction toward coitus with the opposite sex. It is not certain, however, that the bird is really a male. The reaction is practically instantaneous.

### *Nesting Habits*

In view of the paucity of actual nesting records for Bicknell's thrush it seems advisable to summarize the scant information the literature has to offer. For in spite of the fact that the nest and eggs of this form have long been the desideratum of oologists and bird lovers the discovery of occupied nests has been relatively rare. The fact that they inhabit such isolated regions and characteristically build their nests in the most inaccessible places in these areas has been both a challenge and a stumbling block to investigators. Seal Island, however, being less rough and rocky, and having more penetrable woods than the New England mountains, has repeatedly proved its advantages to nest hunters and most of the early efforts of ornithologists were directed toward that paradise of Bicknell's thrush. But the island is in an out-of-the-way place and the breeding season of the birds is short, so barely a half dozen occupied nests have been found. Nevertheless, the combined records known for all of New England, Canada and New York, hardly exceed those found on this diminutive island off the coast of Nova Scotia.

*Nesting Records*

Disclosure of the first nest of this form may possibly be credited to E. P. Bicknell (1882), who, in a footnote, alluded to a thrush nest containing spotted eggs which he found on Slide Mountain at the time of the discovery of this subspecies. But not knowing whether it was the nest of his new thrush or of an olive-back, no further mention of it was made. Had he described the nest and eggs they might now be identifiable, since the nest, eggs, and nest location of these two species are quite different.

Seal Island. The chance discovery by Langille (1884) that this new thrush inhabits Seal Island opened the way for nesting investigations. He says:

> To find the nest of this species was my great desideratum; and though the birds were very numerous it was by no means an easy task. Many an hour did I thread my way through almost impenetrable evergreen thickets, every step muffled on a dense carpet of moss, before I could secure my object.

Finally, however, his "search was rewarded by nests in considerable numbers," but unfortunately he doesn't tell how many of them were occupied. He speaks of the nests of previous years, whose mossy walls, due to the heavy fogs prevailing about the island and to their protected situation in the dense evergreens, have continued to grow *in situ*, becoming "elegant moss baskets, finely ornamented within and without with the living cryptogams." He describes the nests, eggs, songs, and habits of the thrushes, and, although lax about pertinent details regarding his discoveries, his artistic account is admirably informative to say the least.

Apparently Reed (1904) had a nest and eggs of this form in his collection, taken on Seal Island by H. E. Meyer, June 3, 1901, "in a spruce five feet from the ground." No further allusion to it is made.

Bent (unpublished) visited the island for several days in early July, 1904, but apparently the birds were through nesting, for, although perhaps a dozen nests were located in the deep woods, all were old or unoccupied, one only containing an addled egg.

Job (1905) in writing of their Seal Island trip says:

> Their nesting time was now past, but one of the party found a nest on a branch of a spruce 15 feet from the ground. It was deserted, yet in perfect order, and held one blue egg, slightly speckled with brown about the larger end.

The final and perhaps most successful conquest appears to be that of H. F. Tufts (Thayer, 1907; Tufts, 1909) who visited the island from June 8–14, 1907 in the interests of John Thayer who desired a few sets for his collection. Unlike Langille and Bent, Tufts found the birds retiring and suspicious,

> showing none of the 'give-away' weaknesses of most nesting birds. Thus, a female, on the way to her nest with a beak load of building material, happened to stop near where I stood. Instantly she saw me, and after a moment, dropped her load and silently disappeared in the woods. They displayed no signs of alarm upon their nests being approached, usually quietly retiring, if they had been in evidence at all. Males singing in the vicinity of their sitting mates, would become quiet and sneak away at the slightest sound of my approach.

However, he managed to find three occupied nests, from which he collected three sets of three eggs each, waiting several days in the case of two nests for the apparently full complement of three eggs to be laid. He mentions finding two other unfinished nests and a completed empty one. In a letter to Thayer (Thayer, 1907) Tufts wrote:

> The nest is the most difficult to find of any small bird occurring in equal numbers on a given area. The nesting birds are extremely shy and suspicious—this is my experience during two trips to the Island.

Continental nesting sites have been discovered much more slowly. So far as I have been able to determine no nests have been found in Maine, in the Berkshires, or in the Adirondacks, and only one each in the Catskills and in Canada. But persistent and diligent search in the Green Mountains of Vermont and the White Mountains of New Hampshire has been rewarded by a fair number of finds. These will be briefly mentioned in chronological order.

The first positive record in this country appears to concern a nest found in 1894 by Brewster and Faxon on Mt. Moosilauke, New Hampshire. In spite of the early interest of these observers in Bicknell's thrush no published record of the nest was made by them; it is recorded only in the inscription on the label of a specimen in the Boston Society of Natural History — "parent of nest and eggs A/3," — which was

taken on Moosilauke, June 22, 1894. G. M. Allen (1902) mentions the record on the basis of Faxon's verbal report.

The next discovery, though perhaps not a very significant one, appropriately comes from Mt. Mansfield (Davenport, 1902). In connection with this find the author remarks:

> We sought diligently and perseveringly for the nest, but without success. The cover was so dense, the stiff, low-growing branches so interlaced, that it was impossible to penetrate many feet from the road. We searched every available group, sometimes climbing over the tops of low-growing trees where no opening could be made. On June 22, the men were cutting trees to mend the road and when they penetrated a close growth, a pair of birds circled about them, showing great distress. Examination revealed a crushed nest and eggs in the felled tree. The season was not favorable for nest hunting, almost every day in June being in whole or part rainy, and with high winds often making it impossible to keep one's footing in the open on the summit.

Later, in an unpublished list, Mrs. Davenport mentions a nest some one found on Mansfield, in a spruce, containing four eggs.

On June 21, 1904, F. B. Spaulding (1905) made a special trip to Mt. Madison, New Hampshire, in quest of a nest, and, unlike others on similar excursions, he managed to find one with four eggs in only a short time by "following up the notes of one of the birds." A year later Spaulding and Childs (Childs, 1905) found an uncompleted nest on Mt. Adams, June 18th; on June 28th, Spaulding returned and collected the nest with three eggs. An excellent photograph of the nest and eggs *in situ* illustrates a subsequent number of *The Warbler* (Childs, 1905) and also has been reproduced in Knight's, *Birds of Maine* (1908). Later (Childs, 1906), a colored plate of these eggs appeared as the frontispiece of one number of *The Warbler*, in which the editor, John Lewis Childs, remarked: "None of the North American Thrushes lay so beautiful an egg as does the Bicknell's and none are so rare," adding that so far as he knew there were but three sets in existence. According to my records this was correct for that time.

A female in the McKechnie collection at the Museum of Comparative Zoology, dated June 25, 1908, Mt. Madison, bears the additional inscription: "Breeding — shot at the nest."

In the *Oologist* for 1915 appeared a brief note by Abbott entitled "Rare Additions" the rare additions to his collection including "Bicknell's Thrush — nest and three" (Abbott, 1915). No mention of their source is made, but they may have been purchased, since by 1915 there were at least six sets on the market. Published lists of the values of North American birds' eggs, however, set no price on the eggs of this form, although one issue (*Oologist*, 1904) gave the value of the eggs of the gray-cheek as $1.50 per set.

Taverner writes that they (Victoria Memorial Museum, Ottawa) have eggs of *bicknelli* from Perce, Gaspé County, Quebec, taken July 20, 1915. This seems to be the only continental Canadian record. In my experience it is very exceptional to find a nest with eggs as late as July 20, unless they are deserted.

G. H. Ross writes that Mr. Duane E. Kent of Rutland, Vermont, has two sets of eggs, taken on Killington about June 25th, 1922.

Howell informs me in a letter that Thomas Burleigh found two completed but empty nests during the week they spent on Mt. Mansfield in June 1933. Unfortunately it is all too common an experience to find empty nests on Mansfield, the eggs probably having been taken by red squirrels. Burleigh's nests, empty when he and Howell left the mountain June 23rd, may have been robbed nests, or attempts at renesting, but probably not first nests, before oviposition.

Gross writes that at Lost River, New Hampshire, he found a nest with four eggs on July 14, 1933. This is also rather a late record for eggs in a nest, but presumably it represents a second attempt.

Gillet (1935) found a nest on Slide Mountain, which appears to be the only record for the Catskills. The nest, which contained four young, was carefully described, but no date given.

Although the preceding records may perhaps represent only a portion of the nests that have actually been found, I have not been able to find any references relating to others, even with painstaking search. To supplement these records by mentioning some of the unsuccessful quests would be interesting, but its inclusion would be hardly justified here. All of the nests discussed were either collected on sight or merely observed as found, none of them yielding any substantial information on the behavior of the nesting birds or subsequent developments at the nest. It would seem then, very much worthwhile to carry out extended observations at a considerable number of nests through the entire breeding season, in hope of thus illuminating some of the obscure points in the

life history of this little-known thrush. It has been the writer's earnest endeavor to secure some of this essential information, and to that end one entire, and for the most part successful, season, and one rather unsuccessful part of a season, have been spent on their breeding grounds on Mt. Mansfield. The nesting account that follows is based on observations at fourteen occupied nests representing all stages in their history. To these may be added seven deserted or empty nests, a part of whose history can be surmised from the condition and situation of the surviving structure. Nests of previous years, always found in considerable numbers, usually offer some information of value regarding such matters as nest structure, location and height above ground, but otherwise they have been disregarded.

### *Nest Building*

Only very meagre information has been obtained concerning this initial stage in the nesting cycle. There are no hints in the literature regarding nest building except for Tuft's experience just quoted, where a female carrying building material dropped it without going to a nest. This and other incidents led me to be cautious about disturbing the birds at uncompleted nests for fear of desertion, so that observations on the processes of nest construction are seriously curtailed. However, by piecing together the fragmentary observations at several uncompleted nests, as well as by careful dissection of the completed structure, most of the steps in the process can be ascertained.

The first indication of nest building during the summer of 1935 was discovered on the morning of June 4, when a startled bird, quite apparently a female, showed unmistakable signs of attachment to the small grove of 6- to 10-foot balsams from which she had been flushed. During the prolonged search for the suspected nest she boldly remained close by, now withdrawing a few yards, now returning to watch the progress of the search, calling anxiously in low inquiring whistles, but never using the harsh scolding call more typical of the male. A careful examination of every tree in the small area finally revealed the initial stages of a nest—merely several dead twigs and a few strands of fresh green moss loosely laid across three horizontal branches diverging from the trunk of a young nine-foot balsam. The bird discontinued building operations while I remained near and as the prospective nest was not in a position permitting observation from a distance, I withdrew. The site was revisited once that day and several times during the ensuing week, but no addi-

tions had been made to the nest foundation; the adult birds were not observed near, and the nest to all appearances was deserted. Consequently, it was a matter of some surprise to return eleven days later and find a practically completed nest in the old location. So long a delay, however, is not characteristic of their building processes, and the nest was probably actually deserted temporarily, and then returned to, perhaps after an unsatisfactory attempt elsewhere.

The second nest-building discovery, on the morning following the first, was much more informative. My experience at this nest is remindful of that of Tuft's on Seal Island (page 320). A female was encountered with her beak full of building material, but the moment she saw me she slowly dropped the load, shaking her head as if to dislodge the last fragment, and without a sound flew away. She remained within sight, however, and soon dropped to the ground without revealing any nest. Twice more she appeared, first with moss and then a twig, but discarded them also on seeing me. At this juncture two other thrushes, presumably males, put in their appearance, making some fuss on discovering me; but they soon retreated without apparent further interest. In the meantime the industrious female had gathered still another load of building material, and almost went to her nest, which I now noticed for the first time; but still a fourth time the wary bird reluctantly dropped the material. After withdrawing to a vantage point affording some concealment, I was greatly relieved to see the bird renew building operations as if nothing had happened to disturb her. Her first load was deposited on the brim of the nest. Then, lost for a moment among the ferns, she soon reappeared, dropping a beakful of debris into the nest cavity and carefully working it into place with her bill, feet and breast. Several similar trips were made. About two minutes were required to find and bring the material and approximately the same time was taken to arrange it in the nest. All of it appeared to be gathered on the ground nearby and consisted chiefly of the partially decomposed leaf mold with which these birds characteristically build the interior walls of their nests.

The bird's behavior at the nest could be well observed. The material brought to the nest was carefully arranged, first by use of the beak, then by hopping into the nest and working it further into place with the breast and feet. Both lateral and rotary motions were used, the bird often turning a complete circle while sitting in the nest, now and then pausing to make some adjustment with the bill. Sometimes her head would be completely submerged in the nest for a moment, then up would pop her

bright eyes, carefully surveying the surroundings. Working the material into the nest in this manner appears to serve the double purpose of getting it into place and making the nest cavity conform as closely as possible to the size of the bird, thus forming an efficient watershed during incubation and brooding.

During these building operations, a visiting bird, presumably the male, suddenly appeared and drove the female from her work, both of them disappearing quickly among the trees. One of them sang hurried snatches of song during the chase. Although such action seems singular, and antagonistic to the progress of nest construction, it was frequently observed on later occasions during all stages of the nesting cycle, and probably is their sexual flight. In this case the female quickly returned with more material for the nest, and the male remained at a respectful distance, singing.

For fear the birds might desert this nest was not revisited for two days. In the interim the lining had been added and the nest apparently completed ready for the deposition of the first egg. The adult birds were not seen.

On June 6, Mrs. Wallace found a third nest in the process of construction. The female was observed carrying twigs, grasses, and strands of moss to a fork in the branches of a balsam where a nest foundation had been started. Once the bird appeared with a twig nearly a foot long, but nervously dropped this on seeing us, although she went to the nest just the same, and picked aimlessly at the structure. Careful check was kept on this nest in hopes of learning more about the processes of nest building; but no significant additions could be detected from day to day, and the birds abandoned it, apparently building another fifty yards to the south.

The period of time over which nest-building activities are spread may be learned from Table XIII (page 328), which gives the approximate dates of construction for twelve nests. Nest 1 was doubtless started June 4, and Nest 2 must have been under way a day or two earlier. Building proceeds rapidly during the first half of June, for the season is short and the birds have to make the best of it. Building of nests later than the middle of the month is probably more often due to interruptions and desertions of the first nesting site than to belated first attempts. Nest 3(a), completed June 21, is believed to be the second nest of the birds which abandoned Nest 3 after laying the foundations on June 6. Such desertions may be due to our discovery of the nest, to the birds' dissatisfaction with the nesting site, or perhaps even to instability in the

mating relationships at that early date, the possible interchanging of mates perhaps resulting in the selection of a new nesting site. Nest 1, curiously enough, was returned to and completed after being abandoned for more than a week. Nest 10, completed about June 23, is held to be a second attempt following an interruption to the first, because of the sudden renewal of song a few days earlier on an area where the birds had been relatively silent for more than a week. There is reason to believe that it was the second nest of the pair that deserted Nest 6 with four eggs, which was nearby and found deserted on June 21.

Probably nest building is initiated a little earlier in earlier seasons and in more southern regions, but the only other place for which such data are available is Seal Island. Apparently Meyer (Reed, 1904) found a nest there that contained 3 eggs on June 3, 1901. Tufts, however, in 1907, had to wait until June 13 and 14 for eggs to be laid in the empty nests he found.

Nests constructed in July, as already pointed out, seem to be exceedingly rare; but nests broken up in June are followed by rebuilding.

### *Nest Structure*

Very few birds build as beautiful and substantial a nest as do Bicknell's thrushes. Nearly faultless in construction and artistic in design, their outstanding structural feature is the elaborate use of fresh green moss. No other birds in that region build as mossy a nest. The following descriptions, dealing with nest structure and location, are based on the study of more than thirty nests found on or near Mt. Mansfield.

Though there is much variation in the use of building materials, the nests of this form may be roughly classified as of three types. (1) The commonest type is composed chiefly, sometimes almost entirely, of *Calliergon* moss, a bright green pleurocarpous moss profusely trailing over the ground beneath the evergreens and in the nest retaining its freshness so long. (2) Nests of the second type, constructed chiefly of *Sphagnum*, are rather scarce, only two of some thirty or more nests being strictly of this kind.* Varying amounts of this moss, however, are usually used in combination with other mosses and materials. One of the most perfect nests examined was constructed of *Calliergon* and *Sphagnum* combined in approximately equal amounts. The *Sphagnum* nests present a bleached, greenish-white appearance, especially when dry. (3) Sometimes the mossy character of a nest is nearly or entirely masked

*Nests found in 1936, however, included much more *Sphagnum* in their structure.

by the profuse use of twigs and grasses that trim the exterior of the nest, giving it an "un-bicknell-like" appearance. These structures, though substantial, lack the ornamental beauty of the moss nests.

Such a classification is of course an arbitrary one, since all nests contain both twigs and moss, but in greatly varying quantities. The structural composition of individual nests can be learned from Table XIII (page 328).

Observations on nests in the process of construction as well as the dissection of completed structures indicates that they are laid down on a well organized system or plan, consisting of foundation, walls, trimmings, and lining. Nest 1 showed that the foundation is established by simply laying down strands of moss and twigs in the desired location. Then more material is added (as in Nest 3), making a shapeless pile, before the work of arranging it in place is begun. Nest 2 suggests that the walls are next strengthened by inserting twigs and weaving in grasses. Then the interior is molded into a symmetrical bowl-shaped cavity by plastering it with organic debris or leaf mold. To this a lining of rootlets, grass and leaves is later added. On the basis of materials used, then, the nest consists of three parts: (1) the foundation and walls with their trimmings, (2) the interior layer of debris, and (3) the lining.

In the selection of mosses for the body of the nest there is an obvious preference for the bright-green, trailing strands of *Calliergon schreiberi* and other hypnaceous mosses, doubtless not alone because of their abundance but because they pull up so easily and furnish long strands for weaving into a compact structure. A nest may contain several hundred of these pieces, some of them six inches or more in length. The erect tufts of acrocarpous mosses, such as *Sphagnum* and *Polytrichum*, though available in great quantities, are probably not as easily obtained. Inlaid with the mosses are varying amounts of twigs, which give strength and body to the nest; but, when used in excess, they greatly detract from the artistic beauty of the structure and may even advertise the location of the nest by its bulky appearance. The twigs are mainly of spruce and balsam, but those of birch and various deciduous bushes are also sometimes used. Nest twigs may consist of short pieces or relatively long branching pieces that project several inches beyond the wall of the nest. Other items commonly found are grasses, flower stems, the stalks and pinnae of dead ferns, dry leaves, shreds of bark, strips of rotten wood, hair, and lichens. Nest 13 was unique in having its walls ornamented with gray-green, thread-like lichens.

## TABLE XIII

*History of Individual Nests During the Summer of 1935*

| NEST | | | | EGGS | | | | YOUNG | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. | General Structure | Situation | Dates of Construction | No. | Average Dimen. in mm. | Date | Incubation Period | Hatch | Fledged | Nestling Period | Fate of Nest | Per cent Success | Color of Parent |
| Nest 1 | Sphagnum | 5¼ ft. balsam | June 4–15 | 3 | 22.3x16.5 | June 17–19 | June 19–? | none | none | ... | eggs robbed | 0 | ♀ olive ♂ ? |
| Nest 2 | Calliergon and twigs | 9⅚ ft. spruce | June 5, nearly done | 4 | 22.4x17.1 | June 9–12 | June 11–25 | 1 | none | ... | robbed: 3 eggs, 1 young | 0 | ♀ olive ♂ olive |
| Nest 3(a) | Twigs, & grasses | 9 ft. balsam | June 21, completed (2nd attempt) | 3 | 21.3x16.1 | June 22–24 | June 24–? | none | none | ... | eggs robbed—blue jay | 0 | ♀ brown ♂ brown? |
| Nest 4 | Calliergon & Sphag. | 9 ft. balsam | June 8, completed | 4 | 22.6x16.3 | June 10–13 | June 12–26 | 4 | none | ... | 6-day old young robbed | 0 | ♀ olive ♂ olive |
| Nest 5 | Calliergon | 5⅙ ft. balsam | completed about June 13 | 4 | 21.4x17.1 | June 15–18 | June 17?–30 | 3 | 3 | about 12 days | 3 fledged, 1 addled egg | 75 | ♀ brown ♂ brown? |
| Nest 6 | Calliergon | 10 ft. spruce | before June 15 | 4 | 21.6x16.9 | before June 21 | .... | none | none | ... | found deserted | 0 | unknown |
| Nest 7 | Calliergon | 4 ft. balsam | completed about June 10 | 3 | .... | June 12–14 | June 14?–27 | 3 | none | ... | young taken squirrel? | 0 | ♀ olive ♂ unknown |
| Nest 8 | twigs | 5 ft. spruce | completed about June 10 | 4 | 22.5x16.3 | June 12–15 | June 14?–27 | 2 | 2 | 9 and 10 days | 2 fledged, 2 addled eggs | 50 | ♀ olive ♂ olive? |
| Nest 9 | Calliergon | 12 ft., balsam | before June 21 | 3 | 21.5x16.7 | before June 24 | .... | none | none | ... | eggs robbed | 0 | ♀ brown ♂ unknown |
| Nest 10 | Calliergon | 9 ft. spruce | completed about June 23 (2nd attempt) | 4 | .... | June 24–27 | June 25?–? | none | none | ... | eggs robbed | 0 | ♀ olive ♂ olive? |
| Nest 13 | Calliergon and lichens | 4¼ ft. spruce | completed about June 15 | 3 | .... | June 17–19 | June 19? July 2 | 3 | none | ... | disease | 0 | ♀ olive ♂ olive |
| Nest 14 | Calliergon | 6 ft. birch | completed July 9, 2nd nest | 3 | .... | July 10–12 | July 12–24 | 3 | 3 | 13 days | successful | 100 | ♀ olive ♂ olive |
| Nest 15 | Calliergon | 3 ft. balsam | completed about June 21 | 3 | .... | June 23–25 | June 25? July 8 | 3 | 3 | 10 days | successful | 100 | ♀ olive ♂ olive |
| Av. | | 7.04 ft. | | 3.46 | 21.9x16.6 | | approx. 13 days | 1.7 | 0.85 | 11 days | | 24.4 | |

The so-called debris with which the interior walls are formed seems to consist of decayed vegetation, such as leaf mold. Gray-cheeked thrushes in the Mackenzie region are said to use some mud in their nests; but perhaps it is really decayed organic matter as in the case of the Bicknell's. It would be very interesting to know whether the use of such material as a substitute for inorganic mud has any bearing on the origin or fate of the mud-using tendencies of the robin and wood thrush.

The lining is contributed last, perhaps a day or more after the other parts of the nest are completed. It consists mainly of fine, black rootlets which completely refurnish the interior and are woven into the rim of the nest, binding the outer and inner materials together at the brim. Though other writers have spoken of this lining as fern rootlets, I have never been able to settle their specific identity by comparing them with fern or other rootlets on the mountain. They are unquestionably rootlets of some sort, dark brown or black, thread-like, resembling horsehair; but where the birds get them is a mystery. No nests were found without this characteristic lining, usually comprising several hundred pieces. Considerable quantities of clean, well-bleached grass are often used in partial substitution for the rootlets, usually with the inclusion of one to several dead dry leaves. Not infrequently a recently completed nest may have a leaf dropped loosely into it, as if to mask its newness, but during egg deposition it is either removed or worked into the lining.

### *Nest Dimensions*

Dimensional measurements of twenty nests were taken. In measuring the outside and inside diameters both the maximum and minimum were recorded, except in cases where the nests were perfectly circular. The projection of twigs beyond the body of the nest was not included in measurements of the outside diameter. Six nests had the interior cavity perfectly symmetrical but the remaining fourteen showed some distortion of diameter, usually due to compression against the trunk of a tree.

Nests vary in outside diameter from 4 (minimum) to 5.5 (maximum) inches, averaging 4.5 by 5 inches (average of smallest and largest diameters). The minimum and maximum inside diameters were 2.25 and 3.4 inches, averaging 2.47 by 2.79 inches. The outside depth ranges from 2.75 to 3.75 with an average of 3.34 inches, the inside depth from 1.5 to 2.5 with an average of 1.81 inches. These figures may be made more interpretable in Table XIV.

TABLE XIV

*Dimensions of Nests of Bicknell's Thrush*

| | MEASUREMENTS IN INCHES | | AVERAGE | NUMBER OF NESTS |
|---|---|---|---|---|
| | MINIMUM | MAXIMUM | | |
| Outside diameter | 4.00 | 5.50 | 4.50 x 5.00 | 20 |
| Inside diameter | 2.25 | 3.40 | 2.47 x 2.79 | 20 |
| Outside depth | 2.75 | 3.75 | 3.34 | 20 |
| Inside depth | 1.50 | 2.50 | 1.81 | 20 |

Altogether, nests of this form are somewhat bulky, but exceedingly substantial and well constructed, adapted to withstand exposure of the severest kind. They have never been known to come to grief through adverse weather conditions. Though a few nests may fall in ruins at the close of the nesting season, others, due to their solid structure and protected situation, are able to withstand one or more of Mansfield's relentless winters. Old nests of previous years, always found in considerable numbers, are sometimes nearly structurally perfect with their mossy walls still green, but with the interior cavity filled with debris. Seal Island nests, due to the excessive moisture, are said to continue to grow *in situ.*

### *Nest Location*

These thrushes usually locate their nests in the dense evergreen tangles, either in the taller woods characteristic of the 3000-foot zone or in the dwarfed scrub bordering the timberline. Their peculiar preference for the wildest and most impenetrable areas seems more real than imaginary, for on Mansfield many trails have been blazed into the very heart of their breeding grounds and yet they seldom nest beside the trails, though black-polls, myrtles, juncoes and white-throats commonly do. They may choose the relatively sunless interior of a thick clump of trees, or the outskirts of the grove, or sometimes a tree standing apart from others of its kind. Though the northern gray-cheek (McFarlane, 1891) is reported to nest on the ground in the parts of its habitat where trees are not available, there are no ground-nesting records for the smaller subspecies, which apparently always places its nest in trees.

Nests are typically situated in small or medium-sized evergreens, usually somewhere between the middle and the top of the tree. They are most frequently placed where two or more horizontal branches join the main stem, and set close against the trunk so that the impression of the tree is often permanently registered in the wall of the nest. Sometimes, however, the nest may be a few inches, or even a few feet, out from the trunk, but only one out of more than thirty has been found near the extremity of a branch.*

In height above ground (Table XIII, page 328) the nests varied from three to twelve feet. The average of sixteen was 7.3 feet. A few old nests not recorded were higher, but most abandoned nests fall within the range of the given distances. Measured distances are only approximate as the ground beneath the trees is often so uneven that there may be a difference of as much as a foot between the upper and lower side. Nests in the deep woods are commonly higher than those out in the dwarfed groves near the summit, the former being from 8 to 12 feet high, the latter perhaps 5 or 6 feet. Tufts (Thayer, 1907) reported a Seal Island nest 25 feet high and two others at 15 feet; and Job (1905) said his nest was about 15 feet high. This would suggest that Seal Island birds may nest higher, but if these heights are estimates they may be exaggerated, as my own estimates of heights proved to be very inaccurate when the distances were actually measured. Moreover, Bent found a dozen or more nests in the deep woods on Seal Island all about 8 to 10 feet high, which closely corresponds to the heights for Mansfield nests in the deep woods.

Nests have not previously been reported from any trees except balsam and spruce, but three on Mansfield were found in birches — one a successful, second-brood nest, one a deserted nest containing an addled egg and the bones of two half-grown young, and a third the surviving remnants of a mossy nest of the previous year, clinging to the forked top of a birch bush. The birds' apparent preference for balsam rather than spruce is presumably due to the greater abundance of balsams on Mt. Mansfield. Birch trees are always available for nesting purposes, but they do not leave out early enough in June for the first nests. Only for belated nests would they afford adequate concealment.

With few exceptions nests are placed in situations protected from the elements and concealed from inquisitive eyes. Though occasionally

---

*Singularly enough, in the summer of 1936 two nests were found in the terminal twigs of long, low branches of *large* evergreen trees.

visible from a little distance, usually the nest is so concealed that one has to scan a tree closely to discover it. It is still a mystery why they are so bafflingly difficult to locate in areas where the birds are abundant. Many investigators have spent fruitless hours in diligent search carried on for days, and even weeks, without finding any trace of an occupied nest. The small series found in 1935 was the result of prolonged and persistent search in suitable areas at the most favorable times. In many places inhabited by singing males no nests could be found. Although a few nests were located by following up definite clues, the majority were the rewards of blind perseverance.

### *Eggs and Egg Laying*

The eggs of Bicknell's thrush are a beautiful bluish green, lightly spotted with brown. The spotting is their most variable feature and may in some way be correlated with the color phase of the parents. The eggs of the olive-phased bird are usually nearly plain, only sparingly speckled with minute brownish spots, whereas those of brown-backed birds are more heavily blotched. As mentioned in Part I, however, nests of the olive birds sometimes contained two or three nearly immaculate eggs, and one more heavily spotted, but whether this indicates a genetic mixture in the parent, or is merely variation is problematical. The spots may be either uniformly distributed over the whole egg or concentrated about the larger end, and may be represented as minute dots or larger blotches. The eggs of this thrush are definitely smaller and less spotted than those of the northern gray-cheek and the olive-back, the only other *Hylocichlæ* that lay spotted eggs.

Although a northern gray-cheek in the Museum of Comparative Zoology is supposed to be the parent of a nest with six eggs, the smaller subspecies has never been known to lay more than four, and three is perhaps the more usual number. As is evident from Table XIII (page 328), seven nests out of thirteen contained three eggs and six contained four eggs, averaging 3.46 eggs per nest. The dates given for oviposition (Table XIII, page 328) suggest a tendency for earlier nests to have four eggs and later nests only three. Nor is the chart strictly accurate as to the late nests, since some of them were found with three young and were assumed to have had three eggs earlier, — although Nest 2 and Nest 6 demonstrated that one or two eggs can mysteriously disappear without affecting the remaining eggs.

Three eggs has been assumed to be the full complement for Seal

Islands birds, on the basis of the three (or four) nests definitely reported, but more nests would be needed to prove it. Of the six continental nesting records which give sufficient data for determining the number of eggs, four contained four eggs, and two contained three.

Table XIII (page 328) gives the average dimensions of the twenty-nine eggs of eight sets. The eggs vary from 21.0 to 23.0 mm. in length, with an average of 21.9 mm., and in width they range from 16.0 to 17.5 mm., averaging 16.6 mm. The eggs of the olive-backed thrush are typically larger and more heavily spotted. One set of four varied from 23.5 to 25.0 mm. in length and 17.5 to 18.0 mm. in width, averaging 24.25 x 17.88 mm.

**Egg Laying.** Egg laying takes place in the earlier nests before the middle of June, later laying probably indicating some interruption. Table XIII (page 328) gives the dates of egg laying for each nest as nearly as can be calculated. In some cases the dates given were actually observed, but more often they were calculated from other data on the assumption that one egg is laid each day until the set is complete. Thus, when Nest 2 was found to contain one wet egg in a wet nest between 6:00 and 7:00 A.M. on June 10th it was assumed that the egg was laid the day before, and that the other three eggs were laid on successive days following. Nest 4 had two eggs on June 11 at about 8:00 P.M. and unless another egg was laid that night (which is improbable) there seems no doubt but what the first egg was laid on the 10th, the second on the 11th, and the other two on the two following days. Nest 3(a) fortunately yielded a little more positive information. The nest had one wet egg at 6:00 P.M. on June 22. The following morning at 9 A.M. there was still only one egg. At 12 o'clock the bird was on the nest and at 12:40 there were two eggs in the nest. On the following day the bird was on again at 10:30 A.M. and remained there during much of the rest of the day, doubtless adding the third and last egg sometime during the sitting. Egg-laying dates were similarly deduced for other nests from incomplete data. Fear that the birds would desert prevented closer observation. For the most part neither male nor female seems to frequent the nesting site during the egg-laying period.

### *Incubation*

It is believed that the birds begin incubation on the third day of egg laying, not only because the female of Nest 3(a) was observed to do so, but because the young in 3-egg nests appear to hatch approximately

simultaneously. In the case of 4-egg nests incubation is probably likewise started on the third day, with the fourth egg added a day later; but hatching records are hardly adequate for confirming this belief. Nest 4 had one young hatch at least half a day later than the other three, — but it is not known that the egg that hatched last was the last laid. Nest 8, two chicks in a 4-egg nest, showed nearly a day's difference in hatching. Many complications arise, however, in attempting to deduce incubation and hatching dates from the size and apparent age of young in a nest.

The incubation period is believed to be approximately thirteen days; but unfortunately three of the six nests for which egg-laying dates are known were broken up before hatching and the information about their incubation periods lost. In Nest 2, which was carefully watched, only one egg hatched, which may have been the fourth (last) egg hatching on the thirteenth day, or one of the earlier three eggs hatching on the fourteenth day. The hatching of Nest 4 was perfect; three of the young emerged after thirteen full days of incubation, and the fourth, presumably the last egg laid, hatched about half a day later. Thus the incubation period for this nest was between thirteen and fourteen days. The female of Nest 14 had only three eggs and must have started incubating sometime on the 12th of July; hatching was on the 24th of July, the thirteenth day of incubation.

Incubation appears to be entirely the work of one bird, the female. That only one bird of the pair incubates is confirmed by the fact that during observations on sitting birds at nine nests, four of which were closely studied from blinds, a change of mates at the nest during incubation was never seen. The incubating bird frequently leaves the nest, but in all cases it appears to be the same bird that returns. The male occasionally comes to the nest but never sits on it. If the female is on when he appears they often fly away together, and if she is away he may go to the nest, look in, and then fly away. This relationship is further verified during brooding and feeding of the young when the observer learns to distinguish the sexes by their behavior and often by a plumage peculiarity. The male never broods the young, although he faithfully feeds them. That it is the female that incubates, as well as broods, (and not the male, by a reversal of instinct such as is known for certain species) is demonstrated by the fact that incubating females have been collected by three ornithologists, Brewster, McKechnie, and Peters.

The particular reason for dwelling on this point is of course the fact

that the incubating birds sometimes sing on the nest. The foregoing evidence is intended to show that the bird on the nest is a female singing, rather than a male incubating and brooding.

The behavior of incubating females has always been an interesting procedure to watch, and several succeeding paragraphs attempt to present a faithful picture of the mother bird on the nest. Close attention to this aspect of their home life sheds considerable light on avian ways.

The incubating bird ordinarily sits quite low in the deeply-cupped cavity of the nest, so that she is often detectable only by a protruding bill or erected tail. When sitting quietly, especially if trying to avoid detection, the head is retracted, the bill pointing diagonally upward like the tail. This position, though typical, is seldom retained for very long, and some adjustment in posture is soon made.

The incubating bird appears to orient herself on the nest irrespective of surrounding objects. She may be facing any direction at a given time and within a few moments may have turned a complete circle on the nest. Sometimes sitting females face the blind, sometimes turn their backs to it, or again, sit sidewise watching it with one eye. Whatever their position on the nest, one eye is usually fixed on the blind.

The incubating bird is a perfect picture of alertness and watchfulness. Nothing escapes her sharp eye or quick ear. A slight movement or faint noise in the blind, the sudden stir of a mouse or squirrel on the ground, or a bird in a nearby tree will cause her to lift her head till satisfied with the source of the disturbance. Usually she pays no attention to the songs or feeding activities of birds close by, but the whir of wings of her approaching mate will cause her to become instantly alert. Even when the male came from my direction, she would usually hear him first. Often the sitting female would prick up her ears at a sound or disturbance completely escaping my detection, the source of her alarm sometimes making itself evident later in an approaching squirrel or other animal. And like ourselves, they may occasionally be startled by a perfectly harmless object such as a falling leaf.

Though an incubating bird is often considered symbolic of patience and devotedness in the fulfillment of an altruistic duty, Bicknell's thrushes are very restless in performing this task, seldom sitting still for more than a few moments at a time. They leave the nest frequently for feeding and other excuses, sometimes as often as every five or ten minutes during the day. And on the nest they appear quite restless, raising up and resettling themselves, repeatedly assuming different angles of orien-

tation, rolling the eggs, standing up to inspect them, picking in the bottom of the nest, snapping at a passing insect or pulling one down from the boughs overhead. And then the female may hardly be settled snugly on the eggs again, when the male appears in a flash driving his mate for a merry chase through the groves.

The females do considerable preening while incubating, carefully going over all the feathers of the body, straightening out the wing and tail feathers, and scratching the ear coverts and cephalic feathers first with one foot, then the other. They are able to do a surprising amount of feeding at the nest. Often they snap up insects that fly close enough, occasionally hopping off the nest to get them, running out on the nest limb or mounting to a branch above, the click of the bill then telling of the capture. Flying beetles may blunder too close, sometimes alighting on the nest. Ants and other insects crawl up the trunk of the nest tree and are picked off. During brooding, such incidental captures are usually fed to the young.

In spite of the Bicknell's reputation for shyness and easy alarm, the females are close sitters, often allowing one to approach within arm's length. Discouragingly enough this means a nest hunter may pass directly under a high nest or close by a low nest without hope of flushing the incubating bird as a give-away to the nesting site. Only one nest was found by flushing, and that under exceptional circumstances. On the other hand, it means that nesting females are delightful study subjects, seldom taking serious alarm at intrusions. Though at first very cautious about disturbing the birds during the early part of incubation for fear of their desertion, I later learned to put up blinds as soon as the eggs were laid, the bird meanwhile usually sitting watchfully and without apparent alarm through the process. If the nest tree is climbed, the female slips away quietly just before the nest is reached. When the eggs from Nest 2 were measured the sitting bird left the nest, stayed close by calling softly and anxiously while they were being measured, and then settled back quietly on the nest as soon as they were returned. There were exceptions, however, to such behavior, and the female of Nest 8 was so wary that observations even from a distant blind were unsuccessful.

Some observations were made on incubating birds in the rain in expectation of seeing the male feed his mate at the nest, but such cooperation was not evident until the eggs hatched. Apparently the female waits for showers to pass or slow rains to slacken, before abandoning the eggs to feed herself. Nest 2 female, usually in the habit of leaving the nest at

about 10-minute intervals, to be gone nearly that length of time, left only once when watched for an hour in the rain, and was away only five minutes. When she left it was drizzling only lightly. During the rain she sat close upon the nest with her tail held low instead of erect, the wings somewhat extended over the nest brim to form an effective watershed. She frequently shook her wings and tail to dislodge the rain drops, and occasionally stood up for a moment shaking the rain from her feathers. Apparently if the feathers are held down close to the body the water rolls off the back without penetrating, as can be demonstrated by pouring water on a caged bird that does not want to get wet; but if the feathers are ruffled out the bird soon becomes so water-soaked it cannot fly. Birds incubating in the rain, striving to keep the water away from their precious eggs, present a beautiful picture of devotedness and parental solicitude.

Though exhibiting a great deal of individual variation, incubating birds nevertheless adhere rather closely to a daily schedule. Soon after the first light of dawn they leave the nest for feeding purposes, breaking the long night's fast. They may leave as early as 3:30 A.M., when it is still quite dark, or sit half an hour to an hour longer before leaving. They seem to be sleeping just before dawn, and no movements can be detected at the nest, but as the light gradually increases they can be seen to raise up and stretch their wings, often going through a fairly elaborate series of waking-up exercises before leaving the nest. Although they are usually not gone more than 15 minutes before returning to the nest, the female of Nest 4 once stayed away a full hour without harmful consequences to the eggs.

Individual variation is too great to permit generalizations as to the frequency of leaving the nest; but from the first departure in the early morning it is a continual off and on schedule throughout the day. Indeed, Leopold (1933) suggests that "game birds of most species leave the nest for rest and food so frequently and for so long as to suggest that the oscillating temperatures are optimum for incubation." The thrushes seldom stay on for more than half an hour at a time, and usually it is not more than fifteen minutes. Nest 2 female sometimes left as frequently as at 5- to 10-minute intervals. Before leaving the nest they usually look carefully around to see that there is no cause for alarm, and often do likewise before resettling on the eggs. As a rule they pause to inspect the eggs before renewing incubation, but at other times they omit such preliminaries.

As evening approaches, sitting birds become particularly restless, and leave the nest apparently not for mere feeding alone, but to join in the mysterious twilight ceremonies performed by these birds. The male often comes and drives his mate from the nest, and they dart off through the trees, singing, calling, chasing each other, and performing other mysteries of which we may never know. But as the colors of sunset fade and the shadows gather among the trees, the faithful parent returns to her duty, not flying directly to the nest as in daylight, but fluttering blindly among the branches in the semi-darkness, before finally reaching the nest and settling for the night.

The fact that incubating birds (which, I have every reason to believe, are always females), sing on the nest has already been mentioned. The first observation bearing on this question came from Nest 2, in the evening, when the sitting bird suddenly sang from the nest. Although it was too dark to determine which bird of the pair was actually on the nest, another bird, in all probability the male, was singing near the nest tree at the same time. He sang a good deal that night both near the nest and at a distance, and was occasionally answered by a song from the sitting female. The notes of the female were of a somewhat inferior quality, being very low, whisperingly thin, and hoarse. She is not as accomplished a songster as her mate. Once when he indulged in a flight song over the nesting site, the sitting bird responded by another refrain from the nest. These events took place on the ninth day of incubation.

Two evenings later the female at Nest 4 sang six times from the nest. The male was absent much of the evening, but he visited his mate at the nest several times, once perching just below her, and calling softly as she sang from her position above. Still later, in the semi-darkness, a singing male, probably her mate, flew over the nest tree in full song, and the sitting female responded by a loud reply from the nest. Her shadowy form could be dimly seen as she rose up to sing. It was her tenth day of incubation. Nest 3(a) female and Nest 10 female were observed to sing from the nest during earlier stages of incubation.

The best check on singing females came at Nest 2 during the hatching stage, when the bird which had been assumed from the beginning to be the female sang repeatedly in full daylight at times when she could readily be distinguished from the male. She frequently backed upon the nest brim, examined her first cracking egg, and then settled back on the nest, singing again and again in full-throated ecstasy. Her emotion at perceiving the cracked egg with a feebly squirming chick within was all

too evident to escape observation. Could anyone be blamed for believing that her songs were songs of sheer joy and maternal pride, notwithstanding the coldly scientific interpretations of modern behaviorists regarding avian patterns of reaction?

The behavior of the male during incubation, already referred to in several connections, may be conveniently divided into three phases: (1) attention to the female, (2) singing, and (3) other occupations.

From casual observations one might gain the impression that the male pays no attention to the nest during incubation, but continued watching shows that he visits the nest frequently, though irregularly, at all times of the day. Occasional wing flutterings of unseen birds suggest that he may be near by at times when he does not go to the nest. Visits are much more frequent in the morning and evening, when the pair often fly away together, at least in part for feeding purposes. During the day, however, the male may be absent for hours, the early afternoon in particular being a period of rest and quiet. Males have not been observed bringing food to the female during incubation, but may possibly do so during prolonged rains.

The steady decrease in the total output of song as the nesting season advances has been noted under another caption. Observations at many nests during incubation have failed to prove satisfactorily that the male sings more than occasionally near the nest. What little singing takes place at the nesting site might possibly be explained by stray males. If the male sings very much after nesting is begun it is done at some distance from the nest and it is not possible to ascertain exactly what bird is responsible. During the evening hour when song reaches its height, very little of it takes place near enough the nest to arouse suspicion. The female perhaps sings a few songs from the nest, and the male may come and sing in subdued tones near by, or occasionally soar in passionate flight song over the territory, but such performances do not begin to equal the elaborate song program featuring pre-nesting days. It may be concluded, therefore, that though some singing on the part of mated males seems indubitable, they certainly do not sing as ardently as males whose domestic relationships are unsettled. Further proof of this comes to light when a nest is broken up, for the male then returns to the actual nesting site and sings with all the fervor of pre-nesting days, until another nest has been established — if it is not too late to start another nest. This was observed in at least six instances of nest failure.

Apparently the males spend much of their time on the boundaries of

their territories rather than at the actual nesting site. Though this might be interpreted as a necessity for defense against intrusion, controversies between males have never been observed. It seems doubtful if they are sufficiently concentrated on their breeding grounds to necessitate rigid protection against invasion from others of their kind. Moreover, stray birds are sometimes observed to enter another's nesting area and even feed the young in the nest without arousing the resentment of the rightful parents. Perhaps it is habit or instinct that prompts the males to guard their territories, for they certainly are very active in roaming about the nesting area, first on one side, then on the other, wandering in wide circles about the nest, calling repeatedly in tones, now loud and sharp, now soft and low. Perhaps they are advertising and patroling the boundaries of their nesting domain, as territorialists would have us believe, but no observational proof of this was obtained. Their habit of calling on the border lines makes nest hunting particularly futile, since one is apt to follow the voice of the male as the only available clue to a nest, and search in vain along the outskirts of the territory rather than penetrate to the actual nesting site. It is a common experience to disturb a bird in a likely looking grove, where a painstaking search of every tree in the vicinity reveals nothing except perhaps an old abandoned nest of a previous year. The probable explanation for failure to locate the nest under such circumstances is that the startled bird is a male whose nest and sitting female may be at a considerable distance. And since a territory may apparently cover an acre or more the actual nesting grove is likely to be missed completely.

### *Hatching*

As the time of hatching approaches, the incubating bird seems to take an increased interest in the potential life beneath her, frequently pausing to examine and pick at the eggs in an expectant manner. Nest 2 female exhibited such signs more than 24 hours before the hatching. The suddenness with which she frequently backed upon the nest brim to inspect the eggs suggested that she either heard or felt the pulsations of life stirring beneath as the young chicks tried to break the imprisoning shell. On the day before the first egg hatched she brought an insect to the nest and poked it at the eggs as if her feeding instincts were getting ahead of schedule; but, as a matter of fact, subsequent events seemed to indicate that the eggs should have hatched that day.

The following morning at 5:30 one egg had a small crack on the surface of the shell, an opening not wide enough to permit a glimpse within. It appeared to have been picked open from without by the female rather than from the inside by the chick. The female worked persistently at the egg for twelve long hours, now incubating a few moments, now poking and pulling at the shell. She often stood up in the nest and seemed to seize the egg, tugging vigorously till her wings and tail vibrated with the effort. It would seem that such efforts must soon be rewarded by liberating the chick from the shell, but after three hours the crack in the shell was only slightly widened. At other times she seemed to eat pieces of the shell and yet the gap showed no appreciable widening. Possibly she ate the embryonic fluid surrounding the chick as he seemed quite dry when the shell opening was wide enough to permit seeing within. The little fellow could be seen to stir a little, as if trying to kick his way out, but his efforts were very feeble.

The female sang at various intervals during the day, usually a soft sweet song rather than the loud full song of the male. Often it was abbreviated to a few whispered notes. She repeatedly chirped and peeped softly to herself or the young chick. At all times she was a picture of alertness and industriousness.

By noon the shell had opened all the way around except for a persistent hinge on one side, and the bird within could be seen to kick his feet and poke his bill feebly through the slit. He was curled up within the shell, his head bent over upon the abdomen. The work of trying to liberate the imprisoned chick continued throughout the afternoon, until finally, at 5:45 P.M., more than twelve hours after the crack in the shell was first seen, the diligent mother suddenly left the nest in triumph, the entire shell, with the two parts still adhering, in her beak. She disappeared among the trees, so her method of disposal of the shell was not determined. The newly hatched chick was left squirming in helpless nakedness on top of the two unhatched eggs for sixteen minutes; then the female returned, inspected, but did not feed him, and settled to brood. He was a feeble and underdeveloped youngster, and the other eggs did not hatch. This hatching was apparently abnormal, since other females did not have such difficulty in freeing the young.* On the evening of June 25 the four eggs in Nest 4 showed no signs of cracking and the fol-

*In 1936 an egg was observed in the process of hatching. The little chick kicked open the shell and nearly liberated himself during the absence of the parent.

lowing forenoon the female was feeding three young. A few hours later the fourth chick was in the nest with no trace of shells anywhere. Nest 2 was expected to hatch a day earlier than Nest 4; but the hatch was obviously delayed and in the meantime Nest 4 chicks hatched out perfectly, so the process escaped observation. Other nests for which the approximate date of hatching could be ascertained ahead of the actual event were broken up, so that no further observations were secured.

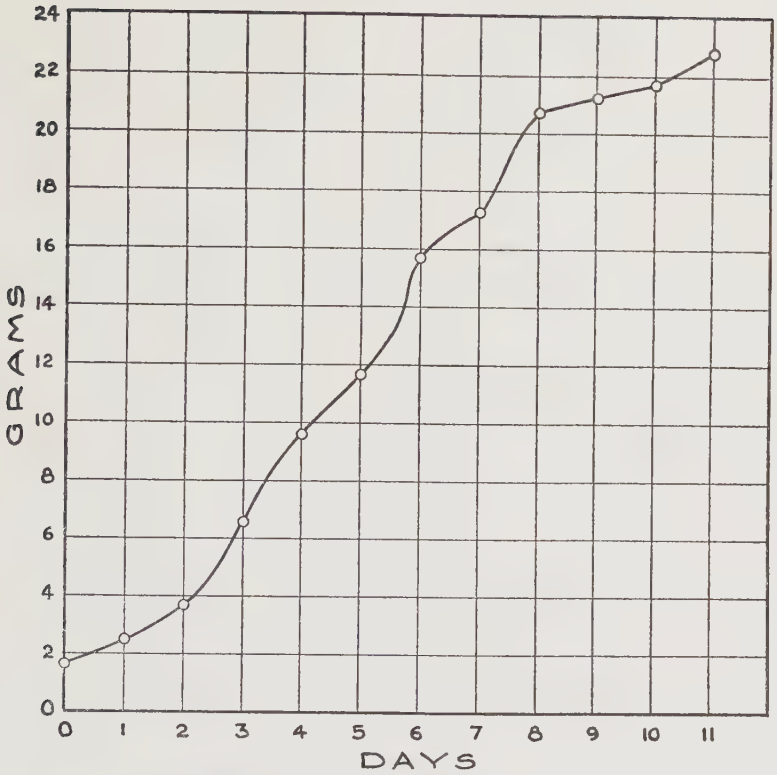
## Care and Development of Young

Studies bearing on the care and development of the nestlings may conveniently be divided into four sections, each of which, in the following account, will be traced from hatching to the departure of the young from the nest. These divisions are: (1) growth and development; (2) feeding; (3) brooding; (4) behavior of the young.

### *Growth and Development*

Since the exact time of hatching is known in the case of so few of the young, the weights, measurements, and development are given for birds during their first, second, and third day, instead of at the usual 24, 48, and 72-hour stages, which of course would be more accurate. Since most of the early nests met with disaster, later nests with half-grown young had to be used to piece out the developmental picture. The age of such young birds can be determined by comparison with measurements and development of nestlings whose age is exactly known. This method of course introduces some error, but it is practically neglible where figures are given for day, rather than hour, of development.

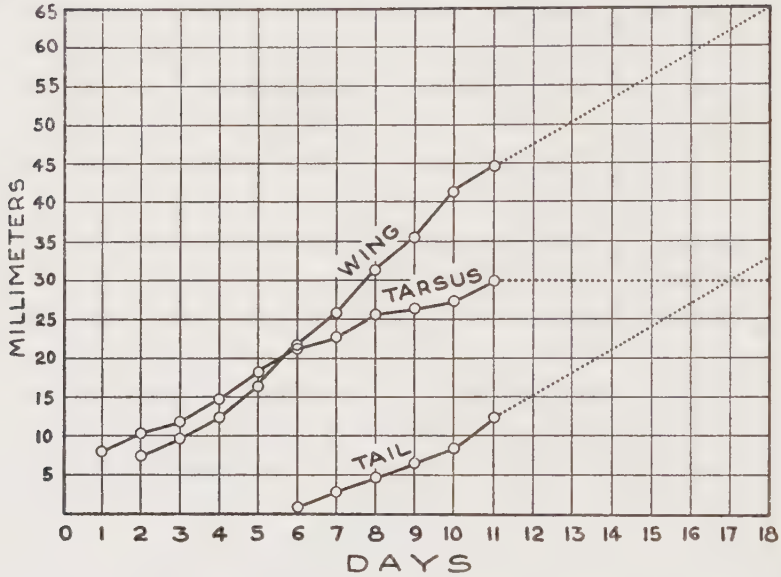
The newly hatched chick is a tiny, squirming creature, blind, helpless, featherless, and entirely naked except for wisps of wet down on the head and dorsal tracts. At first the neck is too weak to raise the head for food and the legs too weak to support the body. The nestlings rest on their abdomen and topple over at the slightest disturbance. The one fledgling whose weight was obtained directly after birth weighed 1.7 grams, probably less than the egg from which he emerged. The tender skin has a flushed, pale red appearance. The margin of the bill is whitish yellow, yellowing with age, and the interior of the mouth is a bright orange. The graphs (pages 343 and 344) picture the growth of the young.




Daily weight increase of nestlings (average of nine).

**The First Day.** Weight 2.5 grams; wing ?; tarsus 8 mm.; (average of three young between six and twelve hours). Dark gray or blackish natal down covers the cephalic, dorsal and humeral tracts, but not the alar, femoral, crural, ventral, or caudal tracts. The future pterylae are not in evidence even as dark dots beneath the skin. The chicks are still very feeble and can raise their heads for food only momentarily before dropping back exhausted. They sit helplessly on swollen, yolk-filled abdomens, trying to maintain balance by use of the weak tarsi. Young birds are essentially poikilothermous at this age, and require fairly constant brooding to prevent chilling.

**The Second Day.** Weight 3.65 grams (average of four a little over 30 hours old); wing, measured from the bend to the tip (really the manus)




Daily growth rate of nestlings (average of twelve).

as in adult wing measurements, 7.8 mm. (average of three); tarsus 10.1 mm. (average of six). Naturally the nestlings are larger and stronger on the second day, with greater ability to gape for food. All the feather tracts are represented by faint black dots showing beneath the skin. Future primaries and secondaries are similarly indicated by rows of black dots, but no feathers are breaking through. Young of Nest 4 peeped very faintly while in the hand, but three other nests of young were not heard to do so.

**The Third Day.** Weight 6.47 grams; wing 9.5 mm.; tarsus 11.8 mm.; (average of nine). All the feather tracts show darkly beneath the skin, giving the young a blackish appearance in the pterylae contrasting sharply with the reddish, blood-suffused apterylae. Primary and secondary feather quills are beginning to push through the skin. Even the nasal region and rump show black dots beneath the skin. Young of Nest 14 peeped quite audibly on the third day. The eye slits were seen to open a little occasionally but perhaps involuntarily.

**The Fourth Day.** Weight 9.8 grams; wing 12.1 mm.; tarsus 14.9 mm.; (average of nine). Primary quills are a millimeter or more in length. Pterylae appear darker. The eye slits frequently open a little.

Peeping for food either in the nest or when handled is a common feature and can be heard several meters away.

**The Fifth Day.** Weight 12.9 grams; wing 16.5 mm.; tarsus 18.2 mm.; (average of nine). The quills of the primaries and secondaries have pushed out 2 to 3 mm. in length. The pin feathers are now piercing the skin on the dorsal and humeral tracts, and sometimes a little on the crural and parts of the ventral tract.

**The Sixth Day.** Weight 15.7 grams; wing 21.7 mm.; tarsus 21.2 mm.; (average of six). All feather tracts show advances in development, but at this age different nests of young show wide variation, apparently due to some pathological disturbance which retards their growth. Some continue to grow normally, but other nestlings become sickly and some die. Two nests out of seven that raised young to this critical age came to complete grief through this sickness, and at least two of the remaining five showed symptoms of illness, but recovered. Their weakness and often consequent death may be due to blood-sucking *Protocalliphora*, but further proof is needed.

**The Seventh Day.** Weight 17.2 grams (average of five); wing 25.8 mm.; tarsus 22.8 mm.; (average of eight). The wing quills have pushed out 10 to 12 mm. and are opening at the end to unsheath the dark feather tips of the remiges. The tips of the tail feathers also begin to emerge. Feathers are now emerging on all the pterylae, blackish on the dorsal and cephalic tracts with the long natal down still adhering. Alar, femoral, and crural feathers are buffy brown with occasional black tips. Ventral tract feathers are black anteriorly, buffy brown and black-tipped further back, and white posteriorly. Buffy upper and lower tail covert feathers surround the emerging retrices. The young may show some fear at being handled, but hunger usually overcomes it.

**The Eighth Day.** Weight 20.7 grams (average of five); wing 31.6 mm.; tarsus 25.8 mm.; tail 4.7 mm.; (average of eight). The fledglings have more feathers. They now usually crouch low in the nest instead of rising up and begging for food from an intruder. They may peep or cry quite loudly in apparent alarm when held, but will eat if fed. Development of fear seems to be associated with improvement in vision, as they show no alarm until the eyes are well opened.

**The Ninth Day.** Weight?; wing 35.6 mm.; tarsus 26.9 mm.; tail 6.8 mm.; (average of five). Still greater feather growth is evident, the feathers spreading over the bare apterylae; but the midventral line, abdomen, sides of back and region beneath wings are still naked. The in-

crease in weight is slight at this age, but weights of Nest 14 young were omitted on this day because of heavy rains, and the two oversized young in Nest 8 which gained 1 and 2 grams respectively, do not constitute a representative average.

**The Tenth Day.** Weight 21.8 grams (average of five); wing 41.7 mm.; tarsus 28.9 mm.; tail 8.3 mm.; (average of eight). The young birds may show some reduction in weight due to excess feather development and loss of abdominal fat. The young appear nearly fully feathered at this age, and are very lively, squirming out of the hand and even hopping away when being measured. They flap their wings considerably and perch on the edge of the nest and look over. At a distance they hear and see the parents bringing food and raise a great clamor. The smaller bird in Nest 8, probably a day younger than his mate, left the nest on his tenth day.

**The Eleventh Day.** Weight — slight increase; wing 44.8 mm.; tarsus 30 mm.; tail 12.5 mm.; (average of three). The young are practically in full juvenile plumage now, but with wisps of natal down adhering to head and dorsal regions. They are essentially ready to leave the nest at this age and usually do if disturbed. They hop actively about the nest as if preparing for departure. The tarsus, toes, and bill are of adult length at this age, but the wings are only half the adult size and the tail about one fifth grown. Measurements of birds in the nest terminate at this date because all birds measured on this day left the nest; those not measured remained one to three days longer. Measurements continued on a nestling retained for study of the post-juvenal molt showed that the wings and tail grew at approximately 3 mm. per day until adult size was attained. The young are of nearly adult weight when they leave the nest.

### *Feeding*

The outstanding problem in the care of a nest of young birds is that of providing sufficient food for their proper growth and development. Particularly in times of bad weather, when the female needs to brood, the problem of securing enough food for the young may become vitally acute, although none were actually observed to starve. The extraordinary appetites of growing young birds is probably too well-known to receive comment here. From dawn until dark it is a constant struggle to supply the food demands of a nestful of hungry youngsters and the major portion of the daylight hours of both parents is ordinarily spent in providing this requisite.

Administering food to newly born young is a task the execution of which requires both precision and patience. The female at Nest 4 accomplished this by bringing small insects, carefully poking the small bits down the nestlings' throats. But the female at Nest 2 was not so efficient and once brought a long caterpillar, which she tried in vain to get down her chick's throat. For nearly an hour she alternated between brooding and attempting to get the nestling to eat the worm, which she held in her beak while brooding. Male birds are typically clumsy in feeding newborn young, and for the most part do not seem to feed them very much at first. Early feedings are less frequent than later ones. Nest 4 female brooded her young for an hour between the first two feedings observed (there may have been previous feedings not observed). The interval of brooding between her second and third trips for food was half an hour; but by afternoon the standard schedule of 10- to 15-minute feedings was attained.

The role played by each parent in the feeding processes varies widely at different nests as well as at the same nest at different times. Ordinarily both parents work cooperatively at this altruistic duty, but the female is more efficient and more punctual. The male at best is irregular, but effectively concentrates his efforts to periods of necessity such as during heavy or prolonged rains and in the early morning, at which times the female remains at the nest to brood. When the male comes to feed the young while the female is brooding she may fly to a neighboring tree, letting him parcel out the insects, or she may remain at the side of the nest, merely moving aside while he feeds the young. An even prettier scene, frequently enacted in the early morning or during the rain, is provided when the brooding mother stays on the nest and takes the food from the male. She opens her bill and the male carefully deposits his whole load in her mouth. This in turn is usually fed to the young; but when they are very small the male may bring more food than they need, in which case the female eats it herself. Sometimes both parents feed the young simultaneously, standing side by side at the nest, seeming to survey their nestlings fondly, and perhaps uttering soft musical chirps as if talking together.

During much of the day, however, contributions from the male are irregular. Sometimes he disappears for hours at a time, perhaps reappearing, after a long absence, without any food, as if to see how his family is getting along. At one nest three adults fed the young, the third probably an extra male; and at another nest the male deserted, leaving the entire care of the young to the female.

An early morning's observation at Nest 4 between 3:30 and 7:00 o'clock, on the nestling's 5th day, gives an instructive picture of feeding activities. The first food was brought by the male at 3:35, when it was still quite dark, and before the female had left the nest from the night's brooding. In the fifteen minutes between 3:45 and 4:00 no less than ten feedings were administered, which is an average of one feeding every 1.5 minutes. This unusual concentration was due to the sudden appearance of two males, both making frequent trips to the nest with food. Later their enthusiasm dwindled so that for the whole morning (three and one-half hours) the average was only one feeding every seven minutes. The two males together made more than twice as many trips as the female, who usually remained to brood, either flying to an adjacent tree while the male fed or else staying to help distribute the food brought to the young. When the young are well fed, as in this case, and do not immediately dispose of the food brought them, the adults promptly clean up the remaining scraps.

The number of feedings, of course, is not a reliable criterion of the frequency with which each nestling is fed, but it was virtually impossible to observe how many and which young were served each time. Sometimes only one is fed at a trip, but more often two or three, and occasionally four, if the nest contains four. The female usually brings a larger load than the male, who frequently carries a single worm or bug and gives it to one bird. The female's contribution is also likely to be more equally distributed, but there are many exceptions both to the size of her load and its distribution. The adults feed more young at a time when they are small, as one large nestling may quickly relieve the parent of all the food brought. There is considerable redistribution of food. If one bird does not promptly swallow what is given him it is quickly taken away and given to another. The female, as already noted, has a precision and ability in administering small portions to very small chicks which the male seems to lack.

The food is characteristically shoved down into the gaping mouths with considerable force, and yet they usually bob up for more. The fact that the parent often dips down several times to push an insect farther into the nestling's throat makes it doubly difficult to determine whether several birds are fed, or one bird fed several times. The young seldom maintain their respective positions in the nest from one feeding to the next, so it is practically impossible to observe how frequently and in what succession individual birds are fed. It is often stated that the

hungriest bird reaches highest and gets the food, and yet it was a common sight to see the mother poise momentarily on the nest brim, carefully scrutinize the clamoring young, and then deliberately feed the bird that raised the least, even when his sibs stood on top of him so he could hardly open his mouth at all.

Frequency of feedings based on averages obtained by counting them over a given number of hours vary all the way from feedings every five to fifteen minutes or more. They are seldom very regular and have a tendency to pile up during certain hours and to thin out at others, depending on the time of day and to a large extent on the contributions of the male. Six or more feedings per hour (or one every ten minutes) is a common average, frequently exceeded when the male is helping, or lowered during rest periods. The afternoon, as already indicated, seems to be a period of inactivity for these thrushes. The male may disappear entirely, not uttering a sound. The female may absent herself from the nest, if the chicks are not too young to be left, returning to feed them at half hour intervals for perhaps a couple of hours, the young in the interim resting quietly in the nest. By four o'clock, however, they are usually back on schedule. It seems probable that the adults rest during this time, since it is a long day from 3:30 A.M. to 8:30 P.M.

Nest 15 afforded an excellent example of the regularity of feedings, since the male did not help and the number of trips by the female could be more easily ascertained. She maintained a consistent 10-minute feeding schedule throughout all the hours of the day, except for a slight slowing down in the early afternoon. The apparently untiring activity of this lone female was a revelation to watch. At the first hint of dawn the search for insects began and continued uninterruptedly till darkness put an end to her labors. Then she brooded the restless young all night. She seemed to take time off neither to feed herself nor to rest.

Though virtually impossible to identify most of the items of food brought to the young, by observing the prevailing insect life in the area it is sometimes possible to get clues as to what is being fed. Great quantities of green or brown lepidopterous larvae are brought to the nest, many of them probably geometrids. Ants, wasps, and other hymenopterous insects are very important items on the bill of fare of both young and adults, as shown by observation at the nest as well as stomach analyses. Ant cocoons proved the most savory morsels we could find for caged specimens, but the adults were not seen to feed them at the nests. Beetles are also eaten in considerable quantities. Some flies are taken,

either by snapping them off foliage or catching them on the wing. Millers and moths (*Noctuidae*) were frequently brought to the nest, and were relished by caged birds, but curiously enough, they were not discovered in stomach analyses (pages 296–298).

Nest 15 contained young at a time when the nymphs of grasshoppers were emerging in the *Vaccinium* patches surrounding the territory, and many were brought to the young. Large blister-beetles (*Epicauta cinerea*) experimentally placed on the nest brim were not even noticed, for some unaccountable reason, and others conspicuous on the *Amelanchier* flowers near by were not brought to the nest.

During August a sudden emergence of saw-fly larvae (*Neurotoma fasciata*?) nearly defoliated all the mountain ash on Mt. Mansfield. It was past the season of nesting thrushes, but one second brood nest was still under observation. The parents brought many of these saw-fly larvae to their young, but the latter did not seem to enjoy them. The caterpillars have a strong, spicy odor which probably affects their taste, and though birds are not supposed to have a well developed sense of taste or smell, the way the young shook their heads and spit out the spicy larvae suggests that such items are distinctly disagreeable. They did eat them, however, after repeated attempts. After the young had flown, the bottom of the nest contained some of these larvae buried in the lining, suggestive of a small boy's habit of throwing bread crusts under the table. Some of these larvae were fed to our tame birds, but had to be tactfully administered in small quantities and at times when they were fairly hungry. The pet that lived would pick at them, toss them about, shake them vigorously, and finally gulp them down quickly — then he would blink his eyes and erect his crest feathers.

A few young birds that died were examined and some of the food items identified. The first examination was of a dead 11-day old bird which had apparently been killed by some predator just after leaving the nest. The stomach contents consisted of one cerambycid beetle, a small snail shell, a green caterpillar, the mangled, chitinous remains of beetles, and fragments (legs, antennae, heads, etc.) of *Hymenoptera* and other unidentifiable insects. A few small, bud-like items suggested some vegetable matter. Later the three dead 7-day old young from Nest 1, 1933, were examined and found to contain lepidopterous larvae, one buprestid (?) larva, a grasshopper nymph (*Melanoplus*), four or five unidentified beetles, ants, and two balsam needles (accidental?)

*Brooding*

The female spends much time brooding, not only when the young are callow, but also when they are well grown and appear not to require such protection. The fact that the parent broods more than has been commonly observed for other passerine birds is doubtless related to the severer climate.

On the forenoon following the hatching of the three young in Nest 4, the female continued to spend most of her time on the nest, perhaps to brood the callow young, perhaps to hatch the remaining egg. The day temperature was about 70° F. Watched during a two-hour period she left the nest twice, the time away from the nest totalling about 20 minutes. During a three-hour period (3 hours and 18 minutes) in the afternoon, she brooded 2 hours and 11 minutes altogether, her absences from the nest totalling 1 hour and 7 minutes. In the evening her brooding time, in seven installments, totalled 40 minutes, the time away 45 minutes. At 8:20, when it was quite dark, she settled to brood for the night.

On the forenoon of the second day she brooded 2¾ hours in eight installments in a 4-hour period, her trips for feeding requiring 1¼ hours. The evening schedule was essentially similar to the preceding evening, but the female was 10 minutes later getting settled to brood for the night.

By the afternoon of the 3rd day, which was warm and sunny, the ratio of brooding to time away had been reversed, the mother remaining away nearly 1½ hours to an hour of brooding.

On the forenoon of the fourth day, during four hours of observation (8:00–12:00), the female maintained an equally divided schedule, eight periods of brooding adding up to two hours, which was precisely the same as the time away from the nest. The temperature was lower (by about 20°) than on the preceding afternoon. The morning is probably a better criterion of brooding schedules.

The following morning, the fifth day, a check was secured on the early morning schedule. As might be expected at such early hours, the female spent most of her time brooding, the male and his partner (the third bird) supplying the food demand of the young. Between 3:30 and 7:00 A.M. she brooded more than 2½ hours and spent less than an hour away from the young. A stiff, chilly wind ruffled her feathers and sometimes nearly toppled her off the nest as she hovered the young. On the seventh day at this nest the parent was still brooding much of the time, but nest disaster prevented further observations.

At Nest 14 the brooding rhythm for the first six days was similar to that given for Nest 4. On the seventh day, the age at which the young of Nest 4 disappeared, the female was brooding only one-third of her time in the morning and probably less in the afternoon. Brooding was largely discontinued after that, but at irregular intervals she hovered the young for 10 to 15 minutes even as late as the eleventh day, when they were old enough to leave the nest. Difficulties arise in attempting to brood a nestful of hungry young birds at that age, as they keep rising up and begging for food. Yet by sitting on the edge of the nest, and chirping in soft but audible whispers to the peeping young, the parent gradually manages to work her way over onto them until they are completely quieted, except for a young head now and then bobbing out at the front or side.

The brooding instinct appears to be remarkably adaptable to variation in temperature, age of young, and emergencies. There is more brooding on cold days than on warm days, and more during the colder parts of a day. In case of rain the female promptly comes to the protection of her young regardless of their age and development. Thus at Nest 14, when the young were near the close of their twelfth day in the nest, the female hurried back to them at the approach of a sudden thunder storm and huddled the frightened young beneath her. The storm that ensued was a violent one, bringing heavy rain mingled with cutting drops of hail, but the valiant mother, partially shielded by a leafy canopy above, withstood the onslaught, the hail and rain rolling off her back in big drops over the edge of the nest without wetting a feather of the young. And yet they were big enough to have left the nest at least a day earlier.

Another instructive lesson in the brooding behavior of this same bird was observed on an excessively rainy morning during the young birds' sixth day in the nest. Through two hours of steady rain the brooding female stayed with the nestlings, not leaving for food for either herself or young. The male, characteristically, rose to the emergency by doing double duty as long as the rain lasted, bringing food to the young at nearly the same rate that both parents ordinarily maintain. At his coming the female always gave a glad little cry, resembling the first syllable of the song, a note characteristic of all females on seeing their mates approach the nest with food. Though accustomed to eat the surplus food brought when the chicks are well fed, on this particular occasion the female ate nothing except the fecal sacs extruded by the young. Similar cases of the timely cooperation between two mates in times of emergency have been witnessed at other nests.

Occasional brooding until the young leave the nest apparently is not an invariable rule. Nest 15 female, deserted by her mate, did not brood during the last three and a half days (the only time when that nest was observed). Her whole day was spent bringing insects, even in the chilly hours at daybreak. Fortunately fair weather prevailed during this time; had inclement weather intervened the success of the nest might have been threatened.

The parent always broods the young at night, as far as I have observed, until the young leave the nest. But Mr. Gillet, who studied Nest 5, tells me that the female did not brood on July 11, which probably was the twelfth night for the young; but it was warm, one nestling had already flown, and the remaining two left in the morning. She did brood, however, on the preceding night, when all three were in the nest.

Brooding, then, among these thrushes is of regular occurrence when the young are callow and is commonly continued, though with decreasing frequency, as long as they remain in the nest. Though obviously essential in such a severe climate when the young are featherless, it may perhaps be carried beyond the point of necessity on some occasions. The female actually seems to enjoy staying at the nest with the chicks and appears exceedingly devoted to them, chirping softly to them in a motherly way. When the young are nearly grown she often sits on the edge of the nest, watching the activities of the young.

### *Disposal of Excreta*

Sanitation at the nest is scrupulously provided for by the adults. Excreta are picked out of the nest as soon as they appear and immediately swallowed. After a few days the young are strong enough to back up to the edge of the nest and deposit the fecal sac on the brim where it is promptly picked up by one of the parents. At practically every feeding one or more of these sacs appear, the young seeming to possess an inherent faculty for defecating at a time when the parent is at the nest to take it. After feeding, the adult usually stands waiting for the appearance of excreta, frequently picking it off the elevated cloaca before it drops. Thus the nest is kept clean and tidy. When the young are nearly full grown there is an increasing tendency to carry the excreta away instead of swallowing it immediately. If carried away it is presumably dropped at a distance instead of eaten, but that cannot be observed. This tendency of carrying it away is more pronounced among the males, which are doubtless better fed, though the fact that the female stays at the

nest to brood may have some bearing on the habit. The feces of very young birds probably contain much nutritive matter due to their imperfectly functioning digestive system, but as digestion is gradually perfected the nutritive value of the feces decreases. The sac appears to be a temporary structure and often is lacking just before the young leave the nest.

Strangely enough, Nest 15 female, who might have been expected to be particularly hungry, always carried the sacs away instead of eating them at the nest. Possibly she ate them away from, instead of at, the nest.

### *Behavior of Young in Nest*

The activities of nestlings seem to consist of three very fundamental features: eating, sleeping, and exercising. The first has been considered. The second, probably taken for granted, needs little additional consideration. When not being fed or clamoring for food they spend practically all their early days and much of their later days in sleep. Sometimes the parents have to wake them by a soft curious little call in order to feed them. It is very amusing to see them waken with a start and then reach upward for food.

Other physical activities of the nestlings are very interesting and assume a role of considerable magnitude during the last days in the nest. When first hatched their movements are very feeble. Indeed the female seems to spend some time straightening them out or untangling them in the nest. But gradually as their necks grow stronger they raise up their gaping mouths waving their heads to and fro in a serpentine manner. As early as the second day they may start peeping audibly and by the sixth day the peeping has developed to a loud clamor audible for a considerable distance. Three nests were found by hearing the loud clamorings of half-grown nestlings. As the young grow older they become more discreet about yelping for food, especially if something has startled them; but they clamor some when fed, even after leaving the nest. Older nestlings when fed rear up on their legs in a desperate effort to reach higher; thus the parents often have difficulty in maintaining a feeding position on the edge of the nest. When not being fed, they elevate themselves, stretch their legs, wings, and neck. They rise up beneath the brooding mother, peeking up through her breast feathers or wings, and sometimes actually push her off the nest by their jostling and crowding. They spend no little time in preening activities, and can even scratch

their heads with their feet. Though often observed to pick one another in the nest, and to jostle, crowd, and push they do not appear to quarrel at all. But they constantly strive to attain the top position in the nest so that one of them gets trampled under foot. Later, however, the trampled victim may emerge from beneath and take a turn at standing or sitting on top of one of his sibs.

### *The Departure from the Nest*

The final days in the nest witness no little preparation for the coming departure. The young become more and more interested in the world outside the nest, peering over the edge at the ground beneath or into the next tree. They may watch passing insects and even snap at them if they come close enough. When a parent leaves the nest after feeding they crane their necks in her direction, watching her depart, even hopping upon the nest brim as if to follow. And when she returns with food they start toward her. They often perch on the edge of the nest, looking out, and flapping their wings as if to take off, then suddenly duck back into the nest. Naturally the extent of pre-nest-leaving activities varies greatly with the age at which they depart. Birds leaving the nest on their eleventh day may be fairly quiet until that time (and undoubtedly leave at that early age only if disturbed), but birds remaining until the fourteenth day may be very active indeed.

Nest 8, which contained two young of unequal size, was vacated July 6, when the largest bird was in his eleventh day (between 10 and 11 days old). His nest mate was a day behind in development and probably nearly a day younger, but left the nest about the same time, when hardly more than 9 days old. That afternoon they were very lively and could hardly be retained long enough to record the weights and measurements. Replaced in the nest they appeared reluctant to stay, but finally quieted down. When Mrs. Wallace returned for photographs a little later the larger bird was perched on a twig above the nest. The smaller one, still in the nest, soon hopped up on the brim, later falling to the ground. When this one was replaced in the nest the larger bird made away, and when the larger bird was brought back the smaller left again. Of course both refused to remain after this and quickly disappeared from view, the larger one hopping from twig to twig until out of sight. Though the parents were not seen they may have been in the thickets near by, this particular pair always proving very wary and suspicious.

That evening I returned to the nesting area and found the male in full

song. Another bird also sang quite frequently, and may possibly have been the female, but more probably was a neighboring male. Rustlings and wing flutters in the underbrush suggested the proximity of the female and young, but they were not positively identified.

The three young in Nest 15 left on the eleventh day. They had been fairly active at preening, stretching, and flapping their wings that morning as well as on the preceding day. When taken from the nest for their daily measurements they crouched low in fear instead of begging for food. Two sat quietly in my lap while the first one was being handled, but when I started on the second bird, the first kept hopping away. The female then put in her appearance. A sharp cry of alarm from one of the young set her to scolding fast and furiously, so that the already disquieted young, now urged on by their scolding mother, suddenly dispersed with astonishing rapidity. Only the smallest one would stay when replaced in the nest, and even he, after crouching quietly for a spell, finally hopped upon the nest rim, looked carefully around, and then made the plunge. The sharp "peeps" of the scattered young constantly advertised their respective locations, but the parent, though present and even aiding in their dispersal by her "chook-chook" notes of alarm, did not appear able to find them. She repeatedly visited the empty nest with food, peered into it, searched all the branches about the nest, and even investigated the ground beneath, as if puzzled and alarmed at the mysterious disappearance of the nestlings. Though they cheeped hungrily on all sides, and though she seemed to recognize their calls, and went to hunt for them, she apparently did not feed them during the hour I remained in the blind, for no answering twitter of feeding was heard. Two hours later, however, the young were being fed, as indicated by frequent clamorings in the underbrush.

Rate of dispersal after leaving the nest is relatively rapid even for 11-day old young, whose capacity for flight is almost nil. The young of Nest 15 remained in the vicinity of the nest during the hour immediately following their departure, but wandered about freely by short, hopping flights. Two hours later only one remained in the nesting grove, which was a small patch of low summit growth covering less than an acre. Another of the young was soon identified about 40 yards southwest of the nesting grove in a clump of bushes; and the remaining one was finally traced to a patch of vegetation some 60 or more yards southeast of the nest. The parent seemed to feed one several times in succession before going to the next bird, doubtless because of their scattered position.

Nest 5 was successful in fledging three young, but was too far away to permit daily study. Mr. Gillet made some observations on this nest, especially on its final stages, and has kindly given me some information relative to the departure of the young from the nest, since, at that time, I had no observations of my own on nest leaving. The first nestling, he says, left at 2:10 P.M. on July 11 (which I assume from earlier measurements must have been the 12th day), and flew the few feet to the next tree just after being fed. The bird experienced some difficulty in maintaining his perch. The other two remained in the nest over-night, leaving the next morning at 6:50, which was probably near the beginning of their 13th day. The parent continued to feed the young out of the nest as long as Mr. Gillet observed them that morning.

The young of Nest 14 did not leave until the morning of their fourteenth day, although they seemed ready two days earlier. Measurements were given up on their tenth day for fear of premature departure as in the case of Nest 15. A sharp thunder shower on their 12th afternoon may have prevented their departure that day. The following night also brought rain, but at 7:20 the next morning the nest was empty. The young were soon located, however, not far from the nest, and the fact that the female soon went to the nest with a worm suggested that they had flown recently, perhaps when I entered the grove. The young were able to make short swift flights of about 25 yards, but one of them was finally captured and retained for further study.

After the nesting season it is a fairly common experience to meet with young in juvenile plumage, usually attended by one of the parents. The fact that more than one young is seldom encountered at one place suggests fairly wide dispersal. Possibly each parent takes charge of one or two young. The adults usually prove bold and resentful if the young are molested. They dart viciously at an intruder, hovering like a hummingbird on rapidly vibrating wings, or flying about close by, scolding with loud, harsh screams, beak wide open and crest feathers erected. When the intruder departs they are apt to follow, screaming harshly as if driving a menace from the neighborhood.

It should be noted, however, that Bicknell's thrushes are not usually great scolders. During the early stages of nesting the female never utters harsh notes. Though the male may come around and scold a little his scolding notes differ very little from the ordinary call, which is penetratingly harsh in its most typical form. But when the young are half-grown or larger the parents may be expected to voice protests at any in-

trusion, provided they have not become accustomed to an observer earlier. If a nest is found with half-grown young and a blind pitched in the vicinity, the nesting birds take it very seriously and may not become reconciled for days; but if the blind is set up at an earlier stage they appear not to object at all.

When the young leave the nest they are entirely dependent upon their parents for food. How soon and by what methods they are educated to forage for themselves is unknown; but they probably acquire independence quite rapidly. Our tamed nestlings soon learned to help themselves to whatever was left in their reach, and learned to pick flies from the window panes with surprising dexterity when held in front of the glass.

### *Breeding Rate and Mortality Factors*

It has already been suggested (page 247) that the limited distribution and relative rarity of Bicknell's thrush may possibly be due more to a slow breeding rate than to highly specialized habitat requirements, especially in sea-level, maritime areas where there appears to be ample room for expansion. A study of Mt. Mansfield's breeding population of thrushes emphatically reinforces this view. Table XV, illustrating their nesting success during the summer of 1935, leaves no doubt as to the reproductive inefficiency of this form, in spite of the ability and resourcefulness of the adults in nest building and care of the young. On the basis of the 13 nests studied in 1935, the females were found to average 3.46 eggs per nest, which is significantly below the average for most passerine birds. Nine nests out of the thirteen came to complete grief, and, of the surviving four, two were only partially successful. Thus their nesting success, or reproductive efficiency, was only 25 per cent; or, calculated on the basis of the total number of eggs (45), the survival rate becomes 24.4 per cent, and the total loss of eggs and young 75.6 per cent. These and other impressive figures are evident in Table XV.

It may also be seen from Table XV that 13 pairs of birds raised only 11 young to the nest-leaving stage, or 0.85 young per pair. At this rate the adults would not be replacing themselves in two seasons. Considering juvenile mortality, adult losses, bachelor birds, and the possibility that all do not mate during their second summer, it seems doubtful if these figures can represent more than a stable, if indeed not a decreasing, population. But of course practically nothing is known regarding the longevity, sex ratios, or completeness of mating among these birds. The

TABLE XV

*Nesting Success of Bicknell's Thrushes During 1935*

| NEST | EGGS | HATCHED | FLEDGED |
|---|---|---|---|
| 1 | 3 | 0 — 0% | 0 |
| 2 | 4 | 1 — 25 | 0 |
| 3 | 3 | 0 — 0 | 0 |
| 4 | 4 | 4 — 100 | 0 |
| 5 | 4 | 3 — 75 | 3 — 75% |
| 6 | 4 | 0 — 0 | 0 |
| 7 | 3 | 3 — 100 | 0 |
| 8 | 4 | 2 — 50 | 2 — 50 |
| 9 | 3 | 0 — 0 | 0 |
| 10 | 4 | 0 — 0 | 0 |
| 13 | 3 | 3 — 100 | 0 |
| 14 | 3 | 3 — 100 | 3 — 100 |
| 15 | 3 | 3 — 100 | 3 — 100 |
| Total 13 | 45 | 22 — 49% | 11 — 24.4% survival |
| Average | 3.46/nest | 1.69/nest | 0.85/nest |

"helper" at Nest 4 suggests the probability of some unmated males; but an excess of females, if such occurred, would doubtless lead to polygamy. Nest hunters might presumably be justified in concluding that there are many non-breeding birds because nests are so hard to find. The results of one summer, however, cannot logically be taken as wholly representative of other seasons. The suddenness with which the eggs and young of the study nests disappeared strongly suggests the role that accidental factors may play.

The fundamental problem with which these breeding percentages are concerned is to determine the agencies responsible for the heavy mortality indicated. Table XVI attempts to estimate losses due to different factors. Thus the failure to hatch of five eggs out of the total of 45 gives an 11 per cent loss due to infertility or defective embryos. But some of the 15 eggs taken before hatching may also have been infertile. Consequently a more accurate estimate would be 5 unhatched eggs out of a possible 30, or about 17 per cent.

Nest 6 with four eggs was found deserted, making a loss of 9 per cent

due to desertion. The reason for the desertion is not known, but the fact that two of the eggs were robbed after the nest was abandoned, and that Nest 10 may have represented a second attempt of the same pair complicates the derivation of percentages.

The eggs of Nest 3(a) are believed to have been taken by a blue jay. Though not a part of the breeding avifauna about the summit, these birds occasionally stray up from the valley below. The harsh screams of one of these intruders, accompanied by the scolding of thrushes, was heard in that vicinity early one morning. A quick visit to the scene disclosed an empty nest, but no trace of either thrush or jay. The former, however, soon returned to the nest, gazed into it and sat upon it in a dazed and bewildered way, now turning in circles on the nest, now standing on the brim and peering at its emptiness. She left and returned several times, but eventually disappeared and was not seen again. This would seem to discredit the view that incubation instincts are so strong that a bird deprived of its eggs will sit on pebbles or an empty nest in response to some compulsory hormonal dictation.

The young of Nest 13 perished as a result of some disease which may possibly have been *Protocalliphora* parasitism (see page 345). When half-grown the nestlings became too weak and sickly to eat, and slowly waned to the point of death in spite of the assiduous devotion of the female parent. Though actually one of them was nursed back to life artificially, in the derivation of percentages it was assumed that he would have died of the illness. This gives a 7 per cent loss due to disease, on the basis of the total number of eggs (45), but if based on the number of young reared to the susceptible age the loss was really three young out of a possible fourteen, or 21.4 per cent. Moreover, in 1933, the three young of the writer's single study nest apparently perished through the same cause. Another nest contained an addled egg and the bones of two half-grown young, a tragedy which may have been traceable to the same destructive agency. It may be seen therefore, that if these eight deaths are actually assignable to a single cause, it is indeed a significantly destructive factor.

The mysterious disappearance of the eggs and young of 6 nests out of 13, or 19 eggs or young out of 45, is still unaccounted for. No visible clue as to the source of destruction was evident except that the nest lining was typically dug up, and occasionally fragments of shells found in the bottom. In Table XVI this is assumed to be the work of red squirrels which seem to be the predators that can most logically be blamed. Weasels are present in moderate numbers, but are mainly terrestrial

hunters like the chipmunks. Coons and wild cats* are too scarce to be responsible. Nest-robbing birds, such as crows and jays, are only infrequent stragglers above 3000 feet. A few hawks and owls, however, such as sharp-shins and screech owls, should be considered; but they were seldom seen, so the entire blame is placed on the red squirrels, which were very abundant. Moreover, they have an unsavory reputation as robbers of birds' nests, and are notoriously addicted to a carnivorous diet, especially in summer. Thus more than half of the total loss (42.22 per cent out of 75.6 per cent) to the 13 nests studied was attributable to squirrels, or other predators, and, furthermore, two infertile eggs and two deserted eggs suffered the same fate. Of the five empty nests of the year that were found in July, at least three showed evidence of having been plundered.

The nests of some other species on Mt. Mansfield seemed to experience similar disasters. Three out of four nests of the olive-backed thrush were unsuccessful. Four of five white-throats' nests were broken up. Two of the four junco nests whose history is known came to grief. And numerous black-polls were found to be unsuccessful in their attempts to rear young.

In spite of the apparent heavy mortality to nesting birds, however, the black-polls, white-throats, and juncos, and possibly the olive-backs and Bicknell's seem to be close to the carrying capacity of the areas they occupy. All of our hylocichlid thrushes either appear to be somewhat intolerant of crowding, or else their productivity is low. Bicknell's thrushes are certainly fully as abundant in their restricted haunts as the olive-backs, hermits, and veeries are in their respective habitats, and in most cases they are much more numerous. Therefore it may be that the Bicknell's thrushes are, on Mt. Mansfield at least, close to their optimum abundance. Whether or not artificial manipulation of some of their limiting factors, such as shooting red squirrels, would actually stimulate their productivity to the extent of either expanding their altitudinal zone or becoming more congested on the occupied areas, or whether the birds would continue to maintain their present level of intensity through the introduction of new and unforeseen limiting factors perhaps in some way related to intolerance to crowding, is an intricate question. It is of course possible that attempts to increase "bicknellian" populations

*Later winter trapping records indicate that bobcats were more abundant than I realized.

might prove harmful in the long run; and possible also that the maligned red squirrel may actually be an important factor in holding Mt. Mansfield birds down to their optimum level of abundance. The squirrel's predation is impartial and doubtless proportional to the abundance of the species concerned.

TABLE XVI

*Mortality Factors Among Nesting Bicknell's*

| FACTOR | NUMBER | PER CENT |
|---|---|---|
| Red squirrel or other predator | 19 (eggs and young) | 42.22 |
| Infertility or defective embryos | 5 (eggs) | 11.11 |
| Desertion | 4 (eggs) | 8.88 |
| Blue jay | 3 (eggs) | 6.67 |
| Disease | 3 (young) | 6.67 |
| Unsuccessful | 34 | 75.6% |
| Successful | 11 | 24.4 |
| Total | 45 | 100.0% |

## The Second Brood

During the summer of 1933 much of July and August was spent hunting for second brood nests. Young birds of an earlier brood were frequently encountered, but practically all indications pointed to the probability that the species was through nesting for that year. A single apparent exception was found on August 7, when in the territory where Nest 1, 1933, had come to grief on July 13, a glimpse of a young bird resembling a juvenile thrush was obtained. Later, faint but unmistakable twittering sounds as of a young bird being fed were heard, but a prolonged search in the area revealed no further trace of either adults or young, and no nest could be found. Nevertheless, in the interim between July 13 and August 7 the pair of birds in question might possibly have had time to rear a second brood to the stage of leaving the nest. But of course the fledgling so fleetingly observed may have been of another species.

In 1935 most of my nests terminated unsuccessfully in early July. The males renewed song immediately, suggesting renesting; but thor-

ough, prolonged, and often repeated searches on the areas in question failed to locate any second nests. Since seventeen earlier nests were found by blindly hunting over any suitable looking territory, it seems extremely improbable that a similar amount of search for later nests, guided by some clues as to their probable location, would not have revealed nests if there had been any to find. And yet on two occasions, once on August 8 and again on August 13, adult birds were observed with food in their beaks; but in neither case could they be traced to a nest, and they may merely have been foraging when disturbed.

The one exception to this rule of a single brood was Nest 14. On July 9 two adult thrushes were watched carrying food into a small grove of evergreens. They persistently remained close by, scolding excitedly. On the following evening, they were still present, still anxious, and still carrying food; yet no trace of the nest or young could be found. But on the outskirts of the evergreen grove, and, surprisingly enough, in a birch tree, was a fresh nest to which the scolding birds paid no attention, either on the first day when it was empty, or on that second evening when it contained one egg. Thus Nest 14 was unmistakably a second nest but whether it belonged to the pair mentioned, which doubtless had first brood young near, or whether it was the nest of another pair is not definite. This late nest, the only one known, hatched out on July 24 three young which left the nest successfully on August 6.

Dr. Gross writes me that he found a nest with four eggs at Lost River, New Hampshire, on July 14 which would be difficult to interpret as anything but a second — unless a very much belated first nest.

## Post-Nesting Activities

Activities of either young or adult are difficult to follow after the nest is left. Though a few may be startled by chance now and then, any observations aside from those already described, where adults are found attending young, are usually very limited. As soon as the young become independent practically all observations cease and the thrushes enter into a quiescent period only rarely broken by a fitful outburst of song or calls. One may spend hours and sometimes days in their most favored haunts without seeing or hearing a single individual. But if one listens carefully in the right places just after sunset a few stray calls may emerge from the depth of the thickets.

*A Study of Caged Specimens*

Some very interesting and almost incredible traits of juvenile behavior have come to light, through a study of two young birds kept in confinement. Though this is not the place for a biography of pets, and though the behavior and development of tame birds cannot be taken as a true criterion of development and behavior in nature, nevertheless it is really remarkable what can be learned from such semi-domesticated wild birds.

As already stated one of the young from Nest 13 was nursed back to life after some sickness had overtaken the nestlings. Too weak and helpless to be fed by bird methods, with the eggs of blue-bottle flies, which in a few hours would hatch into carrion-feeding larvæ, already deposited on his body, there seemed little hope for him. Nearly a hundred fly eggs were removed from his ear cavities. However, after persistent care and forced feeding, he began to show evidence of renewed life. At 11 days of age, the nest-leaving time, he would hop out of his nest and make away, until he finally hopped off the table, suffering a broken tibia which greatly interfered with future hopping and perching, but which gradually completely healed in spite of my crude methods of setting a broken leg.

At fifteen days he started to pick up food for himself, thus eliminating the necessity of feeding by forceps. Clumsy and inaccurate at first, he gradually acquired skill and precision in snatching and manipulating food. At sixteen days, as already stated, he learned to pick small flies off the window panes when held up to them, and a few days later he could manage the big blue-bottle flies with remarkable dexterity. A sudden emergence of Cicadellidæ which infested the cabin when he was seventeen days old made a treat for him. Starting with small numbers and missing many, he gradually increased in accuracy until he could pick off thirty-five or more without stopping. Whether or not because he was taken from the nest before having developed a sense of fear of people, he never seemed to develop it, and to all appearances liked to be held and petted. If left long alone, he began to chirp for attention. When fed he responded by a rapidly repeated "Che-che-che," and when full would withdraw his head, close his beak and repeat his "che-che" notes very softly. He was afraid of live ants, perhaps because of having been bitten by them, but would pounce on other insects with considerable viciousness.

At a very early age he exhibited the evening restlessness characteristic of adult thrushes, protesting against his cage and confinement, and apparently longing to be free; but during the day he seemed perfectly contented.

When only twenty-four days old he made unmistakable attempts to sing, uttering a series of low, vibrant notes linked together into a little tune. After that he often sang softly, almost inaudibly, to himself.

At twenty-five days of age he surprised us by suddenly jumping into his drinking receptacle and taking a complete bath, deliberately swishing around in the water, jumping out and plunging in again, until thoroughly soaked. Then, surprised to discover that he couldn't fly with wet feathers, he proceeded to preen and shake himself until dry. Thereafter he took a bath every day, always of his own volition, a habit which soon proved his undoing. One evening, on his twenty-ninth day of age, when supper was in progress, and before anyone could prevent it, he suddenly plunged into a dish of scalding water on the stove. Though promptly snatched out, it was too late. Death was practically instantaneous and with a few quick gasps he lay still.

Later, one of the young of Nest 14 was taken on the day they left the nest. Having already developed instinctive fear, some trouble was experienced in quieting him, but he rapidly adjusted himself to new circumstances. His continued growth was measured almost daily for a while but the only features of significance were the continued 3 mm. per day growth of wings and tail. The tarsus, toes, and bill were of adult size before he left the nest, and they showed no further growth. His weight fluctuated so much with artificial feeding that it is probably a poor indication of normal weight, but he showed some gain up to 27 grams on his twenty-third day, an average around which adult birds appear to vary. In his first winter he has shown abnormal elongation of the toenails, which have required trimming.

This young bird sang even more precociously than the first captive, making unmistakable attempts to sing when only 15 days old. It was the same soft, whispered song of "zwee-zwee-zwee" notes used by the first bird, uttered without definite pitch or syllable formation. The continued singing of this bird has been described (pages 316–317).

When 27 days old he escaped through an open window and disappeared completely. Many hours of search failed to disclose any signs of him. But seven hours and a half later he was back under the window where his cage was hung, apparently having returned from unknown wanderings. He allowed himself to be picked up and seemed glad to get back, singing in his cage.

Another interesting incident is his swallowing of a large three-inch rubber band (six inches long, if cut and laid on a ruler) when a little over

a month of age. It made him sick for a day or two, so that he often tipped over to one side as if in pain. We fed him laxatives and daily watched his feces for rubber content. After about a week, when we calculated the band had been completely eliminated, he unexpectedly disgorged the band, which was entire and showed no digestive action at all. He still shows a weakness for rubber bands, however, and finds and eats them in spite of our precautions to keep them out of his way.

Though exhibiting some fluctuations in general health, for the most part this young bird has remained in good condition throughout the fall and winter. He has proved to be a delightful pet, playful as a kitten, with an insatiable curiosity, and many other interesting traits of behavior. Although tame to the point of perching quietly on one's hand or knee, he nevertheless resents being caught, protesting such capture by "chook-chook" notes of alarm and anger, even picking viciously at one's hand.

One peculiar habit deserving mention is a comical tap-dancing performance. He often stands on a piece of paper or a wooden object, tapping rapidly with his feet as if beating time. Though such actions were attributed to mere nervousness at first, he now seems to do it purely for the effect of the sound, and cocks his head as he dances upon a resounding surface. This may be related to the dancing steps of a gray-cheeked thrush described by Olive Thorne Miller (Gillet, 1935) who wrote:

> His chosen hour was the approach of evening, when, with body very erect and head thrown up in ecstacy, he lifted his wings high above his back, fluttering them rapidly with a sound like the soft patter of summer rain, while he moved back and forth on his perch with the daintiest of little steps and hops: now up, now down, now across the stage, with gentle noise of feet and wings. No music accompanied it, and none was needed—it was music in itself.

Again, she wrote (Hawkins, 1918, quoting from Miller's *In Nesting Time*, p. 168–169):

> All through the long winter this charming thrush with his two neighbors delighted the house with his peculiar and matchless music and endeared himself by his gentle and lovely disposition. No harsh sound was ever heard from him, and there was no intrusion upon the rights of others, and no vulgar quarrels disturbed his serene soul.

## The Postjuvenal and Postnuptial Molts

Little could be learned of the molting of these birds in August, since they were so little in evidence at that time. A breeding female (Nest 13) collected on July 10 showed no trace of molt, though the remiges and retrices were badly worn. Another female collected August 13 shed feathers so readily that it was difficult to make a study skin, but there was still no trace of incoming feathers and none of the wing or tail feathers had been shed. The adults of Nest 14, caring for young until August 6, showed no visible indications of molting or raggedness of feathers. A full-grown bird still in juvenal plumage was seen on August 9 and judging by the length of the tail was about a month old. In late August and in early September, 1935, the thrushes began to emerge from their seclusion in fresh fall and winter plumage. Specimens collected in early September had completely molted, the new plumage being distinguished not only by its fresh, unworn appearance but by a brighter and more brownish olive color (olive phase) which gradually wears away before another summer. The scapulars of young birds are retained, and, particularly in the fall and to some extent in the spring and following summer, show the buffy tips so characteristic of immaturity in this group of thrushes. The remiges and retrices of immature birds of the olive phase, retained until the second summer, are characterized by a browner appearance than those of older birds, that have been through a postnuptial molt.

The postjuvenal molt was observed in a confined second-brood bird, but of course his time of molting did not correspond to that of young of earlier broods. The initial stages may have escaped detection in spite of close watch, since in preening he frequently pulled out a feather and ate it; but by August 31 feathers were dropping uneaten to the floor of his cage. Bareness was first noted about various head regions, and the posterior nasal region was soon practically featherless, dotted by incoming quills of the new plumage. Feathers next disappeared from the gular region, and then over the entire head and cheeks, new feathers quickly replacing those lost. The back and breast feathers had an unkempt appearance and gradually dropped out. The continued disappearance of buff-tipped dorsal feathers and their replacement by the brownish olive ones of the first winter plumage indicated the progress of the molt. In a little over a week more feather replacement was practically complete, with one buffy juvenile feather clinging to his head and another persisting on the shoulder.

The wing and tail feathers were retained except for one tail feather accidentally broken off in his cage. But during the winter the tail feathers were worn down and broken off so that he was practically tailless for a month. The feathers seemed to become stiff and brittle, but whether due to a deficiency in diet or to the dry atmosphere of a furnace-heated room, or whether they were broken off by mere mechanical friction is not known. In January, however, new retrices unexpectedly appeared, and grew several millimeters a day, till in hardly more than a week from the time they were first detected he had an entirely new and fully grown tail. Careful measurements were not taken as he had personal objections to the process. In late March he began shedding his much frayed primaries, which now (early April) are practically replaced. Many contour feathers are also being renewed, suggesting a complete spring molt.

## Late Summer Revival of Activity

The late summer seclusion comes to a termination in early September with the manifestation of pre-migratory movements. The birds again become active in the woods, feeding among the groves, calling loudly and frequently, and sometimes bursting into snatches of song. On September 6, 1935, at sunrise there was an abundance of calling thrushes about Butler Lodge, and they continued to be loquacious the rest of the forenoon over the whole crest of Mt. Mansfield and across Bear Ridge, though very few of them came into view. A few were heard singing. A scolding bird was collected and proved to be a young male of the year, which helps substantiate the view that the loud scolders are apt to be males. The specimen was in fresh first winter plumage and in good condition, weighing 29 grams. The birds quieted down in the afternoon, but struck up again at the first hint of twilight. Two evenings later the thrushes were active by 6:30. A few singing in relatively unaccomplished tones may have been the young birds experimenting. During the sunset half-hour they flitted about in considerable numbers, again performing, as in the spring, so many twilight-veiled mysteries that the eye and mind were wholly incapable of interpreting them; and once more I was vividly impressed with how little I had actually learned of these wild creatures' ways during my summer's acquaintance with them.

On September 10, unfortunately my last day on the mountain, the birds were still abundant and active, their numbers apparently suffering little if any diminution due to migration.

## Departure from the Mountain

Thus it may be seen that the birds are still in their summer haunts as late as September 10, although they probably do considerable roving. G. M. Allen (1902) reported them still on their breeding grounds in Carter Notch, New Hampshire, on September 15, 1900, when in the early morning he heard one sing and a number calling.

Sweet (1906) heard them calling on Mt. Abraham, Maine, on September 20, both in the forenoon and again at 4:45.

Migration records from southern New England indicate that the thrushes do not leave their mountainous haunts till late September. The earliest fall migration record from Massachusetts is September 18, and there are none earlier from other New England states or New York, the vast majority of the records falling on the final days of the month or in early October.

Then the thrushes wander leisurely along the Atlantic coast to their winter home in the West Indies, where, high up in the mountains, they pass their days — no one knows how. Returning spring, however, finds them starting back toward New England and moving up into their breeding grounds as soon as the retreating ice and snow permit. And once more they feed, and sing, and nest in the shadow of the dense, damp evergreens. At the first hint of twilight, when the sun sinks behind the distant Adirondacks, lighting up the broad expanse of Lake Champlain like a sea of gold, they emerge from their hidden retreats and soar above the trees in full song till the woods and boulders echo the melodious notes; but in the quiet of the daylight hours they continue with their nesting duties in the attempt, so often futile, to rear a brood of young.

## Summary and Conclusions

During the past three years, from 1933 to 1936, the writer has studied Bicknell's thrushes from the taxonomic, distributional, and life-history viewpoints. The latter was the original, and for the most part has been the principal, objective of the research, but a preliminary study of some of the systematic problems involved ultimately led to a complete nomenclatural revision of the species group.

The subject is treated in three parts: (1) the taxonomy and nomenclature of the gray-cheeked (*Hylocichla minima*) group of thrushes; (2) the distribution and migration of the smaller race, Bicknell's thrush; and (3)

studies on the nesting habits and ecology of Bicknell's thrush on Mt. Mansfield, Vermont.

The gray-cheeked thrushes, one of the five species groups of North American, wood-haunting forms of the genus *Hylocichla*, have long bothered systematists dealing with specimens of this group. This confusion is due to lack of specimens, lack of information on the breeding distribution of the various races, an inaccurate standard of measurements for separating the forms, and color inconstancies that were sometimes recognized in the smaller race, but not known in the larger one.

Examination and measurements of some 140 specimens from all parts of the breeding range seem to indicate the natural divisions into which both size races and color forms fall. It seems that the *Hylocichla minima* group, heretofore divided into a northern larger and southern smaller race on the basis of size, can be again separated on the basis of color, each size race forming two color phases which show some geographic segregation. Briefly, the situation is as follows:

*Northern gray-cheeked thrush.* — This race, to which the term "northern" is applied to distinguish it from the succeeding forms, breeds from Labrador (north of the Straits of Belle Isle) northwestward throughout the northern parts of the continent, even extending its breeding frontier into Siberia.

In breeding plumage this form is Grayish Olive above. The fall and winter plumage is plain Olive to Brownish Olive, which rapidly fades in late spring into the typical breeding plumage. A few Alaskan specimens that lack the prevailing grayness suggest an occasional prenuptial molt.

*Newfoundland gray-cheeked thrush.* — This form, heretofore considered identical with the mainland stock, can now be shown on the basis of 45 breeding specimens to differ perceptibly from the continental birds. Though a few skins are practically identical with the mainland form, and a few others nearly so, the majority are distinctly browner, ranging from Olive-Brown to Sepia above. The only morphological difference is the slightly elongated tail of the Newfoundland form. Because of the variability of the Newfoundland skins, and the apparent occurrence of two color forms on the island habitat, as well as the fact that next to nothing is known of the present status of the thrushes there, it seemed advisable to regard the Newfoundland birds as a phase rather than a distinct subspecies.

These brown-backed birds are, however, confined to Newfoundland in summer, and migrate southward along the Atlantic Coast in autumn, wintering in northern South America.

*Bicknell's thrush.* — The smaller race likewise seems to be divided into a northern grayer or olive phase in the St. Lawrence and Nova Scotian regions and a more southern, browner phase perhaps breeding true to type in the Catskills and other of the more southern mountains in New England; but in parts of the Green Mountains of Vermont and the White Mountains of New Hampshire the two color forms occur together, breeding in the same colonies under identical ecological conditions. Nesting studies on Mt. Mansfield failed to reveal any difference in song or breeding habits, except for a slight difference in the spotting of the eggs. The two phases appeared not to cross-mate, in the limited number of matings observed, but specimens from the region indicate considerable intergradation. Because of a seemingly wide overlapping in the distribution of the phases, the fact that their distinctness in the northern and southern parts of the range is indicated by only a few specimens, as well as the virtual impossibility of recognizing the color in many intermediate specimens, it is deemed inadvisable to recognize these forms as separate races. Further study, the writer believes, may reveal that they are potential races.

Bicknell's thrush is distinguished from the larger forms by differences in measurements. Males of the larger races vary in wing length from 98 to 108 mm., averaging 103.2; and females 95 to 104 mm., averaging 98.6 mm. In the smaller race the wing measurements are in the males 89 to 97 mm., averaging 93.0 and in the females 81 to 95 mm., averaging 88.1 mm. (All measurements are inclusive and based solely on breeding birds.) Tail, tarsal, and bill measurements are less dependable criteria for subspecific determination.

The names previously applied to these gray-cheeks are no longer tenable, since the oldest type, Lafresnaye's *Turdus minimus*, regarded up to the present time as the type specimen of Bicknell's thrush, can now clearly be shown, on the basis of measurements as well as winter distribution, to be the larger gray-cheeked thrush. Consequently the name *minima* can no longer be correctly applied to Bicknell's thrush, but henceforth must be used to designate the larger race, heretofore known as *aliciæ*. Ridgway's name of *bicknelli*, rejected in 1919 as a result of Bangs' rediscovery of Lafresnaye's type, must now be restored to Bicknell's thrush.

Accordingly the forms with the corrected names are:

*Hylocichla minima minima* (Lafresnaye). — Northern and Newfoundland gray-cheeked thrushes.

*Hylocichla minima bicknelli* Ridgway. — Bicknell's gray-cheeked thrushes.

In Part II, dealing with the distribution and migration of Bicknell's thrush, are assembled all the available locality records for this form. The appendix includes a list of these records with complete data and measurements. The localities concerned are more fully discussed in the text.

Bicknell's thrush breeds sparingly in the Canadian Labrador (from Natashquan eastward), Gaspé, Magdalen Islands, Seal Island, and probably the Mud Islands and West Cape. These are the only known maritime records. This form is both rare and local in the Canadian provinces.

In the United States, Bicknell's thrush is strictly a montane form, occurring nowhere (in summer) except at relatively high altitudes on the highest mountains. The areas inhabited are Maine (Mts. Katahdin, Abraham, and Bigelow), practically all of the White Mountains of New Hampshire, the Green Mountains of Vermont, and probably most of the Adirondacks of New York. The southernmost outposts are the Berkshires of Massachusetts (Mt. Greylock), and the Catskills of New York (Slide Mt., Mt. Wittenberg).

This race, including both color phases and apparent intermediates, reaches its maximum abundance in central Vermont and New Hampshire. This suggests that the birds are limited in their northward and southward distribution by highly specialized habitat requirements among which altitude, humidity, temperature, and evergreen forests play a significant role. Nesting studies carried out on Mt. Mansfield, Vermont, suggest that in addition to limitations imposed by environment the population is restricted by a low breeding rate. They lay three eggs as often as four, and seldom attempt a second brood; the loss due to infertility and defective embryos is high; and the loss due to predators, chiefly red squirrels, is more than 50 per cent.

Bicknell's thrush migrates southward in late September and early October along the Atlantic coast, seldom occurring very far inland. Specimen records thin out so rapidly in the southern states as to suggest three routes of migration from North Carolina southward, but only one of the routes can be fully verified. Some migrants may leave the coast at the Carolinas, taking the straightest over-water route to the Bahamas. Some obviously continue along the Atlantic coast to Florida, then cross to the Bahamas and Haiti. Others apparently swerve westward into northwestern Georgia, along a route seemingly destined to take them

toward Louisiana and the Gulf; but specimens diminish to such an extent in the latter region that this route is supported by only a few dubious intermediates.

The many records of the occurrence of the smaller form in interior regions such as the Great Lakes states, can now be shown, on the basis of a revised set of measurements which justifies lowering the minimum dimensions of the larger form, to be largely erroneous. The few remaining authentic records from the interior are best explained as accidental records.

Bicknell's thrush winters, so far as known, in Haiti and San Domingo, apparently in the mountains. This is based on four indubitable specimens and three probable ones. There are no authentic records for South America.

Part III deals with life-history studies conducted on Mt. Mansfield in the north central part of Vermont during the summers of 1933 and 1935.

Mt. Mansfield (4393 feet) is the highest of the Green Mountains, and is the central and dominating feature in a long chain of peaks. Its extensive, rocky summit has a true timberline invaded by hardy ericaceous shrubs and alpine plants. Climatic conditions are relatively severe. Average monthly temperatures during the summer hardly exceed 50° F. Rainfall is heavy, with frequent storms and high winds, especially on the open ledges. Clouds hang over the higher peaks much of the day.

The region comprises a number of life zones. The lower slopes are covered with the Beech-Maple Forest Association, inhabited by typical sub-Canadian flora and fauna. Upwardly this merges through a transition zone into the true upper Canadian elements found in the Abies-Picea Association. Above the evergreen forest, out on the exposed ledges, may occur true Hudsonian and even sometimes arctic-alpine forms. Bicknell's thrushes are for the most part restricted to the evergreen zone, having an altitudinal distribution of about 1500 feet. Except for the black-poll warbler and the white-throated sparrow they are probably the most abundant of the birds above 3000 feet.

The thrushes arrive on their breeding grounds between the 25th and 30th of May. Approximate dates of arrival can be set both by observations and by migration records in southern New England.

Thrushes of this form are the most insectivorous of the hylocichlids, and in summer, as indicated by seven stomachs examined by the Biological Survey, their diet is almost entirely of animal matter. In late

summer and fall they consume considerable quantities of berries; but two young thrushes kept in confinement could never be brought to subsist entirely or even largely on fruit, suggesting that what fruit they take is secondary to a habitually animal diet. The caged birds also indicated a natural desire for leafy matter, such as fresh lettuce.

The song of Bicknell's thrush has received considerable attention in the literature. It is structurally similar to that of the veery, but distinguished from it chiefly by an emphatic break a little past the middle of the song. It is introduced by two or three low plucking notes, audible only at close range. The preliminary notes are hurriedly followed by two to four, usually three, high-pitched, vibrant, ringing phrases which break, usually on the third syllable, into several merged, climax notes of higher pitch and increased intensity. This characteristic bar is held momentarily, then imperceptibly glides into the closing notes which are not emphasized. The song is repeated over and over till the evergreen groves resound with the ringing melody.

These thrushes have an elaborate flight song. Every evening, directly after sunset, they emerge from the shadowy groves and soar over the trees and ledges, singing ardently on the wing. Several are often singing in the air at once, till earth and sky echoes with their mingled voices.

They are preeminently evening singers, but, especially in the early part of the season, they sing much during the morning and forenoon. Their habit of singing more on misty and rainy days has often been noted.

Seasonal duration of song is very short and is apparently correlated with the nesting cycle. Song production is at its height in early June, but wanes rapidly after the middle of the month, during the time of incubation and feeding of the young. Singing in late June is apparently more often due to unmated birds, or birds whose nesting cycle has been interrupted, than to nesting birds. There is an early July revival of song that is concurrent with dissolution of nesting cares when the young are fledged; but after that, song wanes into almost complete silence until pre-migratory movements occasionally produce fitful outbursts of singing.

One unexpected discovery in connection with song is the occurrence of singing among the females. Females on the nest (the only place where they can be identified), sing frequently during incubation, hatching, and brooding.

The characteristic call note is the loud, harsh, slurred whistle *feé ah,*

but there are many softer modifications of this, as well as numerous other call notes. At the nest the calls seem to assume a role of actual communication between the adults and young.

A young thrush, reared in almost complete isolation since his fourteenth day, gradually acquired all of the call notes characteristic of his race, most of which he never heard. His song, however, actually begun when he was only fifteen days old, was always more or less random and experimental, never broken up into the syllables of the adult song, until he was taken back to Mt. Mansfield the following summer, when he learned to imitate the wild birds.

Nesting studies are based chiefly on the thirteen nests whose complete history was known, all of them found in the summer of 1935. Nests studied during a previous summer, and other, unoccupied nests, a part of whose history can be determined from the situation and condition of the surviving structure, more than double this number of study nests.

Nest building may start as early as the first days of June. A few strands of moss and twigs are first laid across two or more horizontal branches of a small or medium-sized evergreen. More material is then heaped up, the walls being shaped and strengthened by the use of the twigs. The interior cavity is filled with decayed leaf mold, the builder sitting in the nest, working the material in place with rotary motions of the body. A lining of delicate black fern rootlets is next added, often including a few grasses and a dry leaf or two.

The completed structure is exceedingly substantial and well built, adapted to withstand considerable weathering. It is also of exceptional ornamental beauty, being composed almost entirely of fresh green mosses, either the trailing strands of various Hypnaceae, or, less frequently, of *Sphagnum*. Sometimes, however, nests are mainly of twigs.

The nests are typically situated in dense evergreen groves, securely saddled on two or more horizontal branches where they join the trunk. They range from 3 to 15 feet from the ground. Though usually built in balsam or spruce trees, late nests may sometimes be placed in birches. Nest structures may persist through one to several winters in spite of the severe weather.

Three or four greenish blue, spotted eggs are laid, one a day till the clutch is complete. Incubation starts on the third day when the third egg is laid. The incubation period is approximately 13 days.

Incubating females are always watchful and alert, but very restless. They leave the nest at 10- to 15-minute intervals throughout the day,

but sit longer during prolonged rain. They are particularly restless in the evening and leave frequently, often in company with the males which may come and drive them from the nest for a sexual flight through the trees. The females return to brood at the onset of darkness, often having difficulty in finding the way back to the nest. In the morning they leave for feeding purposes at the first hint of dawn.

Males spend much of their time on the boundaries of the territory, but visit the nest frequently. They were not observed to feed the females during incubation, but did so after the eggs hatched.

At hatching time the eggs apparently crack around the middle and the chicks, with or without the help of the parent, work their way out of the shell, which is then carried away by the females.

The featherless young have wisps of natal down only on the cephalic, dorsal, and sometimes humeral tracts, but within a day or more the black dots of prospective feather tracts show beneath the skin. On the fourth and fifth days the pin feathers pierce the skin and on the sixth and seventh days the feathers begin to unsheath, growing out rapidly until the nest is left.

Young are fed at about 10-minute intervals. Both parents share in the feeding duties, but the female is more punctual and efficient. The male works faithfully, however, during emergency periods, such as in the early morning when the female remains to brood, and during rains, when the male may do all the feeding.

The female broods the young nearly half the time until the fifth or sixth day, after which she broods at intervals until the young leave the nest. Brooding is correlated with temperature, time of day and weather conditions. She broods continually during rains, even when the young are old enough to leave the nest.

The young leave the nest at ten to thirteen days of age, but apparently depart at the earlier age only if disturbed. They are very active during the last days in the nest. After the departure they are accompanied and fed for some time by the parents.

The thirteen nests studied gave a survival rate of only 24.4 per cent, or 0.85 young per pair. Considering other destructive factors such as juvenile mortality, adult losses, and non-breeding birds, it seems doubtful if this is more than a replacing, if not indeed a decreasing, population, Predators (red squirrels) appear to be the principal limiting factor. Other losses are due to infertility, defective embryos, and a disease that frequently afflicts half-grown young.

Two young thrushes kept in confinement yielded much interesting information relating to juvenile development and behavior. A few days after nest-leaving age they learned to feed themselves, and though awkward at manipulating insects at first, they soon acquired such precision and dexterity that they could snap moving flies from the window panes. One learned to bathe daily, but the other has always been irregular in that feature. The latter has been retained over winter, and has proved to be a charming and remarkable pet, being very active, playful, and musical.

In August the adults pass through a complete postnuptial molt, but juveniles shed only the contour feathers, retaining the remiges and retrices until the close of the succeeding summer. The pet bird, however, did not follow the schedule, and grew a new tail in mid-winter, and had a spring molt.

By early September the thrushes emerge from late summer retirement, and become active again in the woods. They remain in their mountainous haunts till about September 20th, then move gradually southward to their winter home in the West Indies.

The necessarily extended nature of this paper is by no means intended to imply that the final word has been written regarding Bicknell's thrush. In many respects this research seems to have exposed more problems for future investigation than it has solved. The actual systematic relationship among the grey-cheeked thrushes appears to be very intricate, and their origin and evolution is a problem that merits careful attention. The taxonomic significance of the two coincident color phases of Bicknell's thrush in New England is a particularly challenging subject for future study. And further taxonomic studies will avail little until distribution is better known. Morevoer, the observations on the home life of this interesting thrush have yielded only incomplete information regarding many of the fundamental features in its life history. An especially significant problem for continued research is the low breeding rate of this form, studied in relation to its limited distribution and scarcity. Such a study, the writer believes, would reveal some valuable information concerning productivity, limiting factors, and the interrelationships of populations.

## LITERATURE CITED

ABBOTT, GERARD A.
1915. ". . . Rare Additions," *Oologist*, **32**, p. 157.

ALLEN, CHESLEY.
1916. "Birds of Yarmouth and Vicinity," *Proc. Nova Scotia Inst. Sci.*, **14**, p. 94.

ALLEN, FRANCIS H.
1895. "Some Notes on Cape Breton Summer Birds," *Auk*, **12**, p. 90.
1898. "Bicknell's Thrush on Mt. Katahdin, Maine," *Auk*, **15**, pp. 60–61.
1908. "Summer Birds of the Green Mountain Region of Southern Vermont," *Auk*, **25**, pp. 63–64.
1930. "The Song of the Bicknell Thrush: A Correction," *Auk*, **47**, pp. 263–265.

ALLEN, GLOVER M.
1902. "List of the Birds of New Hampshire," *Proc. Man. Inst. Sci.*, **4**, pp. 40–183.

ALLEN, J. A.
1900. "List of Birds from Santa Marta, Colombia," *Bull. Amer. Mus. Nat. Hist.*, **13**, p. 183.

*A.O.U. Check-list of North American Birds.*
1886. 1st ed., p. 342.
1895. 2nd ed., p. 317.
1910. 3rd ed., p. 360.
1931. 4th ed., p. 260.

ARTHUR, STANLEY CLISBY.
1918. "The Birds of Louisiana," *Louis. Dept. Cons. Bull.*, **5**, p. 74.

AUSTIN, OLIVER L.
1932. "Birds of Newfoundland Labrador," *Memoirs Nutt. Ornith. Club*, **7**, p. 171.

BAGG, AARON C.
1923. "The Connecticut Valley—A Highway for Bird Migration," *Auk* **40**, 1923, pp. 256–275. (P. 263).

BAILEY, HAROLD H.
1925. *Birds of Florida.* Williams and Wilkins Co., Baltimore, Md., p. 144.

BAIRD, SPENCER F.
1858. *U.S. Pacific R.R. Surveys*, **9**, p. 217.
1864. "Review of American Birds," *Smith. Misc. Coll.*, **181**, Part I, pp. 11–21.

BANGS, OUTRAM.
1898. "Some Birds from Santa Marta, Colombia," *Proc. Biol. Soc. Wash.*, **12**, p. 144.

BANGS, OUTRAM, AND PENARD, THOMAS E.
1919. "Some Critical Notes on Birds," *Bull. Mus. Comp. Zool.*, **63**, p. 30.

BEAL, F. E. L.
1915. "Food Habits on the Thrushes of the United States," *U.S. Dept. of Agri., Bull.* **280**, pp. 11–13.

BENNITT, RUDOLPH.
1932. "Check-list of the Birds of Missouri," *Univ. Missouri Studies: Quarterly of Research*, **7**, no. 3, p. 49.

BENT, A. C.
1908. "Summer Birds of Southwestern Saskatchewan," *Auk*, **25**, 1908, p. 34.

BERLEPSCH AND HARTET.
1902. *Novit. Zool.*, **9**, p. 3.

BICKNELL, EUGENE P.
1882. "A Sketch of the Home of *Hylocichla aliciae bicknelli*, Ridgway, with some Critical Remarks on the Allies of the New Race." *Bull. Nutt. Ornith. Club*, **7**, pp. 152–159.
1882. "A Review of the Summer Birds of the Catskills with remarks on the Faunal and Floral Features of the Region." *Trans. Linn. Soc. of New York*, **1**, pp. 117–168.

*Birds of America.*
1936. Garden City Publishing Co., Garden City, N. Y., pp. 229–231.

BISHOP, LOUIS.
1889. "Birds of Magdalen Islands," *Auk*, **6**, p. 149.

BOND, JAMES.
1928. "Distribution and Habits of the Birds of Haiti," *Proc. Acad. Nat. Sci. Phil.*, **80**, p. 509.

BREWSTER, WILLIAM.
1883. "Bicknell's Thrush (*Turdus aliciae bicknelli*) in New England," *Bull. Nutt. Ornith. Club*, **8**, pp. 12–17.
1895. "Addition to Mr. Minot's List of the Land Birds and Game Birds of New England," Appendix of H. D. Minot's *Land Birds and Game Birds of New England*, pp. 466–468.
1906. "Birds of the Cambridge Region," *Memoirs of the Nutt. Ornith. Club*, **4**, pp. 386–387.

BRIMLEY, C. S.
1890. "Additions to the Avifauna of North Carolina and Raleigh in 1889," *Ornith. and Oologist*, **15**, p. 23.
1917. "Migration at Raleigh, N. C." *Auk*, **34**. p. 302.

BRYANT, HENRY.
1860. "On Two Birds from Bogota," *Proc. Bost. Soc. Nat. Hist.* **7**, p. 226.

BURNS, FRANKLIN L.
1919. *The Ornithology of Chester County, Pennsylvania.* The Gorham Press, Boston, p. 111.

BURROUGHS, JOHN.
1895. *Riverby.* The Riverside Press, Cambridge, Mass., pp. 45–46, 54.

CAIRNS, JOHN S.
1889. "Summer Birds of Buncombe County, North Carolina," *Ornith. and Oologist*, **14**, p. 23.

CAMERON, E. S.
1908. "Birds of Custer and Dawson Counties, Montana," *Auk.* **25**, p. 54.

CAMPBELL, LOUIS W.
1934. "Bicknell's Thrush Taken Near Toledo, Ohio," *Auk*, **51**, p. 241.

CARTER, JOHN D.
1907. *Abstract of the Proc. of the D.V.O.C.* for 1907. *Cassinia* **11**, p. 86.
1904. "Summer Birds of Pocono Lake, Monroe County, Pennsylvania," *Cassinia, Proc. D.V.O.C.*, **8**, p. 35.

CHADBOURNE, ARTHUR.
1887. "On Summer Birds of the White Mountains," *Auk*, **4**, pp. 102, 103, 107.

CHAPMAN, F. M.
1917. "Distribution of Bird Life in Colombia," *Bull. Amer. Mus. Nat. Hist.* **36**, p. 537.

CHERRIE, GEO. K.
1896. "Ornithology of San Domingo," *Field Mus. Nat. Hist. Publ.*, **1**, p. 9.
1909. "A Spring Record for Bicknell's Thrush on Long Island," *Auk*, **26**, p. 196.

CHILDS, JOHN LEWIS.
1905. "A Night Among the Clouds with Bicknell's Thrush," *The Warbler*, vol. **1**, no. **3**, pp. 67–69.
1906. "Eggs of Bicknell's Thrush," *The Warbler*, vol. **2**, no. **3**, plate III, fig. 1.
1906a. "Ornithological Collections of John Lewis Childs, Floral Park, N. Y.," *The Warbler*, vol. **2**, no. **4**, p. 105.

COALE, HENRY K.
1916. "Bicknell's Thrush in Northeastern Illinois," *Auk*, **33**, p. 203.

COOKE, MAY THATCHER.
1921. "Birds of the Washington Region," *Proc. Biol. Soc. Wash.*, **34**, p. 13.
1929. "Birds of the Washington Region," *Proc. Biol. Soc. Wash.*, **42**, p. 65.

COREY, ALICE.
1913. "Bicknell's Thrush in Franconia Notch, N. H.," *Auk*, **30**, p. 589.

CORY, CHARLES.
1891. "On a Collection of Birds—Bahama Islands," *Auk*, **8**, p. 352.

COUES, ELLIOTT.
1861. "Notes of the Birds of Labrador," *Proc. Acad. Nat. Sci.*, p. 217.
1884. *Key to North American Birds*, 2nd ed., p. 248.
1903. *Key to North American Birds*, 5th ed., p. 256.

DALEY, MARY WOOD.
1922. "Birds of Frost Valley, Slide Mt. Region, Southern Catskills," *Auk*, **39**, pp. 176–179.

DARLINGTON, P. J., JR.
1931. "Notes on the Birds of Rio Frio, Magdalena, Colombia," *Bull. M.C.Z.*, **71**, p. 407.

DAVENPORT, MRS. ELIZABETH B.
1903. "Birds Observed on Mt. Mansfield and in Stowe Valley in 1902," *Wilson Bull.*, **10**, pp. 77–86.

DEMILLE, JOHN.
1926. "Birds of Gaspé County, Quebec," *Auk*, **43**, p. 526.

DUTCHER, WILLIAM.
1886. "Bird Notes from Long Island, N. Y.," *Auk*, **3**, p. 443.

EATON, ELON HOWARD.
1910. *The Birds of New York*. N. Y. State Museum, Albany, N. Y., **1**, pp. 15, 41, 49, 50; **2**, pp. 22, 522.

EATON, WARREN F. AND CURRY, HASKELL B.
1926. "Summer Birds of Vermont, particularly of the 'Long Trail' through the Green Mountains," *Vt. Bot. and Bird Club. Joint Bull.* **11**, June, 1926, pp. 53–62.

EMILIO, S. G.
1932. "Annotated List of Birds Observed in Essex County during 1932," *Bull. Essex Ornith. Club*, p. 32.

FAXON, WALTER.
1889. "On Summer Birds of Berkshire County, Mass." *Auk*, **1**, July, 1889, pp. 42 and 106.
1895. "*Turdus a. bicknelli*—in Berkshire County, Mass.," *Auk*, **12**, pp. 392–393.

FAXON, WALTER AND ALLEN, F. H.
1888. "Birds of the White Mountain Region, N. H.," *Auk*, **5**, p. 153.

FAXON, WALTER AND HOFFMAN, RALPH.
1900. "Birds of Berkshire County, Mass.," *Faunal Papers on Ornith.* New England, **1**, p. 11.
1922. "Birds of Berkshire County, Mass.," *Auk*, **39**, p. 66.

FLEMING, JAMES.
1907. "Birds of Toronto, Canada," *Auk*, **24**, p. 88.

FORBUSH, E. H.
1929. *Birds of Massachusetts and other New England States*, Mass. Dept. Agric., Part III, pp. 395–397.

FORD, E. R., SANBORN, C. C., AND COURSON, C. B.
1934. "Birds of the Chicago Region," *Chic. Acad. Sci.*, May, 1934, p. 56.

GILLET, LOUIS B.
1935. "The Thrushes of Our Woods," *Yale Review*, pp. 743–759.

GUNDLACH, JEAN.
1871. "Neue Beiträge zur Ornithologie Cubas," *Jour. fur Ornith.*, p. 293.

GREENE, EARLE R.
1934. "Bicknell's Thrush (*Hylocichla minima minima*) in Georgia." *Auk*, **51**, p. 241.

GRISCOM, LUDLOW.
1923. "Birds of the New York City Region," American Museum Handbook Series, no. 9, pp. 372–373.
1932. "Bird Life in Guatemala." *Bull. Amer. Mus. Nat. Hist.*, **64**, p. 309.

HAWKINS, CHAUNCEY J.
1918. "Sexual Selection and Bird Song," *Auk*, **35**, p. 432.

HELLMAYR, C. E.
1934. *Catalogue of the Birds of the Americas*, Field Museum of Natural History Publication. Zoölogical Series, vol. 13, part 7, p. 459.

HERSEY, E. SEYMOUR.
1917. "Birds of St. Michaels, Alaska," *Auk*, **34**, p. 159.

HOFFMAN, RALPH.
1904. *Birds of New England and Eastern New York*, pp. 77–78.

HOLT, ERNEST G.
1921. "Annotated List of the Avery Bird Collection in the Alabama Museum," *Museum Paper no.* **4**, *Ala. Mus. Nat. Hist.*, p. 134.

HOWE, R. H., JR.
1902. "Notes on the Summer Birds of Berkshire County, Mass.," *Auk*, **19**, p. 405.
1902. "A Review of Perkins' *Birds of Vermont*," *Contr. to N. A. Ornith.*, pp. 6–24.

HOWE, R. H., JR. AND STURTEVANT.
1899. *The Birds of Rhode Island*, p. 87.

HOWELL, A. H.
1890. "Day at Rockaway Beach," *Ornith. and Oologist*, **15**, pp. 170–171.
1893. "On the Occurrence of Three Rare Birds on Long Island, N. Y.," *Auk*, **10**, p. 91.
1899. "Notes on two Rare Birds from Lond Island, N. Y.," *Auk*, **16**, p. 85.
1901. "A Preliminary List of the Summer Birds of Mt. Mansfield, Vt.," *Auk*, **18**, pp. 337–347.

HOWES, PAUL G.
1928. "Notes on the Birds of Stamford, Conn.," *Oologist*, **45**, p. 96.

JENNEY, C. F.
1911. *Record of Walks and Talks with Nature*, **4**, p. 173.

JOB, H. K.
1905. *Wild Wings*. Houghton Mifflin and Co.; Boston and New York. pp. 184–185.

KNIGHT, ORA W.
1908. *Birds of Maine;* Bangor, Maine, p. 653.

LAFRESNAYE, FREDERIC.
1848. "Habitat ad Bogotam, in Nova Grenada," *Revue Zoologique*, no. 1, Jan., 1848, p. 5.

LANGILLE, REV. J. H.
1884. "Bicknell's Thrush," *Auk*, **1**, July 1884, pp. 268–270.
1892. *Our Birds in Their Haunts*, New York: Orange Judd Co., pp. 511–513.

LAWRENCE, GEORGE N.
1867. "Catalogue of a Collection of Birds, made in New Granada, by James McLeannen," *Ann. Lyc. Nat. Hist. N. Y.*, **8**, p. 7.
1868 (1870) *Ann. Lyc. Nat. Hist. N. Y.* 9, p. 91.

LEOPOLD, ALDO.
1933. *Game Management.* Charles Scribner's Sons; New York, London. p. 367.

LEWIS, HARRISON.
1920. "The Black-poll Warbler and Bicknell's Thrush at Yarmouth, Nova Scotia," *Auk*, **37**, p. 591.

LOOMIS, LEVERETT.
1887. "Another Addition to the Avifauna of South Carolina," *Auk*, **4**, p. 261.
1891. "On Birds of Chester County, South Carolina," *Auk*, **8**, p. 173.
1894. "Birds of Chester County, South Carolina," *Auk*, **11**, p. 110.

LONNBERG.
1929. *Fauna och Flora*, p. 98.

MCFARLANE, R.
1891. "Birds of Arctic America," *Proc. U.S. Nat. Mus.*, **14**, p. 445.

MATHEWS, F. SCHUYLER.
1921. *Field Book of Wild Birds and Their Music.* G. P. Putnam's Sons, Knickerbocker Press: New York, pp. 249–252.

MAYNARD, C. J.
1910. *Record of Walks and Talks with Nature*, **3**, p. 120.

MAYNARD, MRS. L. W.
1902. *Birds of Washington and Vicinity*, Woodward and Lothrop. Wash., D. C. p. 178.

MERRIAM, C. HART.
1884. "Turdus aliciae bicknelli," *Auk*, **1**, p. 58.

NOBLE, G. K.
1919. "Avifauna of Newfoundland," *Bull. Mus. Comp. Zool.*, **62**, pp. 543–567.

NORTON, ARTHUR.
1909. "Bicknell's Thrush in Cumberland County, Maine," *Auk*, **26**, p. 312.

*Oologist*, **21**, 1904. p. 110.
PEARSON, T. G.; BRIMLEY, C. S. AND H. H.
1919. *Birds of North Carolina, N. C. Geol. Sur.*, **4**, p. 331.

PERKINS, EDWARD H.
1922. "Bicknell's Thrush in Maine," *Bird Lore*, **24**, p. 150.

REED, CHESTER A.
1904. *North American Birds' Eggs.* Doubleday, Page and Co., N. Y.

RIDGWAY, ROBERT.
1881. "Descriptions of Two New Thrushes from the United States," *Proc. of the U.S. Nat. Mus.*, **4**, pp. 377–378.
1889. "Natural History Survey of Illinois." *Ornithology*, **1**, p. 59.
1907. "Birds of North and Middle America," *Bull. U.S. Nat. Mus.*, **50**, part IV, pp. 1–180.
1912. *Color Standards and Color Nomenclature*, Washington, D. C.

ROBERTS, T. S.
1932. *Birds of Minnesota.* Univ. of Minn. Press, vol. 2, 1932, p. 131.

ROGERS, CHARLES.
1928. "Bicknell's Thrush in Northeastern New Jersey," *Auk*, **45**, p. 225.

ROSS, DR. AND MRS. LUCRETIUS.
1924. *Vt. Bot. and Bird Club*, Joint Bull., **10**, Dec. 1924, p. 17.

RUSLING, WILLIAM J.
"Bicknell's Thrush in Virginia," *Auk*, **54**, 1937, p. 395.

SAGE, J. H., BISHOP, L. B., AND BLISS, W. P.
1913. *Birds of Connecticut. Conn. Geol. and Nat. Hist. Sur.*, p. 178.

SALVIN, O.
1870. "The Birds of Veragua," *Proc. Zool. Soc. London*, p. 180.
1885. "Birds of British Guiana," *Ibis*, p. 197.
1888. "Birds of the Islands of the Coast of Yucatan," *Ibis*, p. 243.

SALVIN, C., AND GODMAN, FREDERICK D.
1904. *Biologia Centrali-Americana.* Introd. to Aves volumes, Nov. 1904, p. xiii.

SAUNDERS, ARETAS A.
1929. "Summer Birds of the Northern Adirondack Mountains," *Roos. Wild Life Bull.*, vol. 5, no. 3, p. 368.
1929. *Bird Song.* N. Y. State Mus. Handbook 7, Albany, N. Y.
1935. *A Guide to Bird Song.* D. Appleton-Century Co.; New York, London, pp. 144–146.

SAUNDERS, W. E.
1905. "Birds New to Ontario," *Ottawa Nat.*, p. 206.

SCLATER, P. L.
1854. "List of a Collection of Birds Received by Mr. Gould from Quijos, Ecuador," *Proc. Zool. Soc. London*, p. 111.
1855. "On the Birds Received in Collections from Santa Fe Di Bogota," *Proc. Zool. Soc. London*, p. 145.
1857. "A Collection of Birds made by Signor Botteri in Southern Mexico," *Proc. Zool. Soc. London*, p. 212.

1859. "Birds Received by Verreaux from Ecuador, (Rio Napo)," *Proc. Zool. Soc. London*, p. 64.

SEEBOHM, HENRY.
1881. *Cat. Birds Brit. Mus.*, **5**, p. 202.

SPAULDING, F. B.
1905. "Breeding of the Bicknell's Thrush," *The Warbler*, vol. 1, no. 2, pp. 41–42.

STONE, WITMER.
1894. *Birds of Eastern Pennsylvania and New Jersey*, D.V.O.C.; Phil., p. 150.

SWEET, DANA W.
1906. "Bicknell's Thrush on Mt. Abraham," *Jour. of Maine Ornith. Soc.*, vol. 8, no. 4, pp. 81–84.

TACZANOWSKI AND BERLEPSCH.
1885. "Birds from Ecuador," *Proc. Zool. Soc. London*, p. 70.

THAYER, JOHN E.
1907. ". . . Nesting of Bicknell's Thrush," *Oologist*, 24, p. 120.

THORNE, PLATT.
1895. "Birds of Fort Keogh, Montana," *Auk*, **12**, p. 218.

TORREY, BRADFORD.
1889. "Bicknell's Thrush Breeding in Vermont," *Auk*, **6**, p. 194.
1896. *The Footpath Way*, pp. 94–95.

TOWNSEND, CHARLES.
1917. "In Audubon's Labrador," *Auk*, **34**, p. 145.

TOWNSEND, CHARLES AND ALLEN, G. M.
1907. "Birds of Labrador," *Proc. Bost. Soc. of Nat. Hist.*, **33**, p. 417.

TUFTS, H. F.
1909. "Breeding Notes," Macoun's *Cat. of Canadian Birds.*, Dept. of Mines. Geol. Sur., pp. 739–740.

VERRILL, A. E. AND A. H.
1909. "Notes on the Birds of San Domingo," *Proc. Acad. Nat. Sci. Phil.*, p. 366.

WARREN, B. H.
1888. *Birds of Pennsylvania*, E. K. Myers, Harrisburg, p. 249.
1890. *Birds of Pennsylvania*, 2nd ed., Harrisburg, p. 326.

WAYNE, ARTHUR T.
1910. "Birds of South Carolina," *Contr. Charleston Museum*, p. 201.
1918. "Six Birds from Georgia," *Auk*, **35**, p. 486.

WETMORE, ALEX. AND SWALES, BRADSHAW.
1931. "The Birds of Haiti and the Dominican Republic," *U.S. Nat. Mus. Bull.* **155**, p. 340.

WEYGANDT, CORNELIUS.
1905. "Summer Birds of Broadhead's Creek, Monroe County, Pennsylvania," *Cassinia, Proc. D.V.O.C.*, **9**, pp. 20, 75.

WEYL, EDWARD.
1927. "Notes from the Mt. Marcy Region," *Auk*, **44**, p. 113.

WHITTLE, HELEN G.
1920. "A Town of Five Thrushes," *Bird Lore*, **22**, p. 218.

WRIGHT, HORACE W.
1909. *Birds of the Boston Public Garden*, Hough. Miff. Co., p. 198.

# APPENDIX

## MEASUREMENTS OF NORTHERN GRAY-CHEEKED THRUSHES FROM BREEDING RANGE

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | SIBERIA | | | | | | | |
| Thayer | 21800 | ♂ | Nijne Kolymak | June 8, 1915 | .. | 104 | 68 | — | 14 | gray breeding plumage |
| | | | ALASKA | | | | | | | |
| Thayer | 20301 | ♀ | Nome | July 8, 1913 | Koran | 100–1 | 68 | 30 | 13 | gray breeding plumage |
| | 20302 | ♂ | Nome | July 13, 1913 | Koran | 105–6 | 63 | 31 | 12 | color of migrant |
| | 20303 | ♂ | Nome | Aug. 13, 1913 | Koran | 101 | 70 | 32 | 12 | color of migrant |
| | 20306 | ♀ | Nome | Aug. 8, 1913 | Koran | 96 | 65 | 30 | 12 | fresh fall plumage |
| | 20307 | ♀ | Nome | Aug. 13, 1913 | Koran | 97–8 | 65 | 30 | 12 | fresh fall plumage |
| | 17761 | ♂ | Dexter Cr., Nome | July 15, 1910 | Koran | 108 | 74 | 33 | 12 | gray breeding plumage |
| Bent | 6140 | ♂ | Nome | July 13, 1911 | Bent | 103.5 | 71 | 31 | 13 | .... |
| Nat. Mus. | 106635 | –im. | Port Clarence | Aug. 30, 1885 | Townsend | 102 | 70 | 30 | 12 | fresh fall plumage |
| | 170016 | ♂ ad. | Port Clarence | July 12, 1899 | Cole | 101 | 70 | 30 | 14 | gray breeding plumage |
| Biol. Sur. | 165026 | ♂ ad. | Port Clarence | July 12, 1899 | Fisher | 101 (fr.) | 69 | 31 | 13 | very gray |
| Nat. Mus. | 106630 | ♀ im. | Kowak R. | July 4, 1885 | Townsend | 99 | 64 | 28 | 12.5 | gray breeding plumage |
| | 106631 | ♂ | Kowak R. | July 4, 1885 | Townsend | 105 | 68 | 30.5 | 14 | gray breeding plumage |
| | 106633 | ♂ | Kowak R. | July 4, 1885 | Townsend | 104 (? fr.) | 70 | 29 | 13 | gray breeding plumage, badly frayed |
| Biol. Sur. | 239704 | ♀ juv. | Kokwok | Aug. 17, 1911 | Hanna | 99–100 | 65 | 28 | 13 | juvenile plumage |
| | 183982 | ♀ ? juv. ? | Kakhtul R. | Aug. 29, 1902 | Osgood | 97 | 66 | 30 | .. | fresh fall plumage, quite brown |
| Nat. Mus. | 92076 | ♀ | L. Alloknagik | June 16, 1881 | .... | 99–100 | 68 | 30 | 12 | gray breeding plumage |
| Biol. Sur. | 231304 | ♀ ad. | L. Aleknagik | June 17, 1911 | Hanna | 96–7 | 63 | 30 | 13 | not especially gray |
| Nat. Mus. | 70160 | ♂ | St. Michaels | .. .. .. | Leronis | 103 (fr.) | 67 | 30.5 | 13 | gray breeding plumage |
| | 75378 | ♂ ad. | St. Michaels | June 17, 1878 | .... | 107 | 67 | 31.5 | 14 | gray breeding plumage |
| | 75379 | ♂ im. | St. Michaels | June 7, 1878 | .... | 100 | 65 | 30 | 14 | color of migrant |
| | 75380 | ♀ | St. Michaels | June .. 1878 | .... | 104 | 72 | 31 | 13 | gray breeding plumage |
| | 81304 | ♂ ad. | St. Michaels | June 5, 1880 | .... | 102 | 66 | 31 | 14 | gray breeding plumage |
| | 96657 | – juv. | St. Michaels | Aug. 25, 1880 | Nelson | 102 | 72 | 31 | 14 | juvenile plumage |
| | 255175 | ♀ * | St. Paul Is. | Sept. 9, 1917 | Hanna | 108 | 70 | 30 | 12 | fall plumage |
| | 332607 | ♂ ad. | McKinley Park | May 31, 1932 | Dixon | 99 | 67 | 31 | 13 | gray breeding plumage |
| | 86538 | ♂ | Nushagak | June 9, 1881 | .... | 102 | 62.5 | 30.5 | 13 | gray breeding plumage |
| Biol. Sur. | 231303 | ♀ ad. | Nushagak | May 31, 1911 | Hanna | 102 | 66 | 30 | 12 | not especially gray |
| | 231305 | ♂ im. | Nushagak | June 2, 1911 | Hanna | 100 | 63 | 30 | 12 | not especially gray |
| Nat. Mus. | 58700 | .. | Ft. Kenai | June 3, 1869 | .... | 98–9 (fr.) | 60 (fr.) | 30 | 11 | not yet in breeding plumage |
| Biol. Sur. | 187184 | ♀ ad. | Circle | July 12, 1903 | Osgood | 94 (fr.) | 65 (fr.) | 29 | 14 | gray breeding plumage |
| | 187185 | ♀ ad. | Circle | July 12, 1903 | Osgood | 95 | 63 | 28 | 13 | gray breeding plumage |
| | 187186 | ♂ ad. | Circle | July 13, 1903 | Osgood | .. (fr.) | 68 | 31 | 13 | gray breeding plumage |
| | 187187 | ♂ ad. | Circle | July 13, 1903 | Osgood | 101 | 68 | 31 | 12 | gray breeding plumage |
| | 187225 | ♀ ad. | Circle | July 17, 1903 | Hollister | 96 | 68 | 28 | 14 | not especially gray |
| Nat. Mus. | 110165 | ♀ ad. | Cape Lisbonne | May 31, 1886 | .... | 101 | 67 | 30 | 14 | brownish—poor specimen (?) |
| | 54242 | – ad. | Kodiak Is. | June 28, 1868 | Minor | 108 (♂) | 71 | 33 | 13 | not especially gray |

*This is apparently the specimen on which Ridgway based his maximum wing length for females of the larger form, but measurements of several hundred specimens now clearly indicate that this bird must be wrongly sexed.

MEASUREMENTS OF NORTHERN GRAY-CHEEKED THRUSHES FROM BREEDING RANGE

(continued)

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | YUKON | | | | | | | |
| Biol. Sur. | 194748 | ♂ ad. | Coal Cr. | Aug. 6, 1904 | Osgood | 104 | 68 | 29 | 12 | not especially gray |
| | | | MACKENZIE | | | | | | | |
| Nat. Mus. | 43194 | ♀ ad. | Fort Anderson | June 11, 1864 | MacFarlane | 95 | 65 | 28 | 13 | Nest and 4 eggs. Fairly gray |
| M. C. Z. | 6365 | ♀ | Fort Anderson | June 14, 1864 | MacFarlane | (very poor skin) | | | | Gray. Nest and 6 eggs |
| | 6366 | ♀ | Fort Anderson | June 14, 1864 | MacFarlane | 100 | 63 | 29 | 13 | Gray. Nest and 4 eggs |
| | 27210 | .. | Fort Good Hope | May 31, .. | Kennicott | 104 | 63.5 | 28 | 14 | nearing breeding plumage |
| Biol. Sur. | 195053 | ♂ ad. | Willow R. | May 17, 1904 | Mills | 103–4 | 64 | 28 | .. | hardly in breeding plumage |
| | 206226 | ♂ im. | Great Slave L. | May 28, 1908 | Jones | 98–100 | 63 | 30 | 12.5 | gray breeding plumage |
| | 206227 | ♀ im. | Great Slave L. | May 29, 1908 | Jones | 98 | 64 | 30 | 12 | hardly in breeding plumage |
| | 183287 | ♀ ad. | Fort Rae | July 23, 1901 | Preble | 99 (fr.) | 68 | 30 | 13 | gray breeding plumage |
| | 195052 | ♀ ad. | Mackenzie R. | June 19, 1904 | Preble | 98 | 63 | 30 | 12.5 | gray breeding plumage |
| | | | MANITOBA | | | | | | | |
| Biol. Sur. | 167239 | ♀ ad. | York Factory | July 13, 1900 | Preble | 100 | 63 | 30 | 13 | gray breeding plumage |
| R. O. M. Z. | 31, 8, 14, 60 | ♂ | Fort Churchill | June 13, 1931 | Twomey | 106 | 72 | 31 | 13 | gray breeding plumage |
| R. O. M. Z. | 34, 11, 15, 29 | ♂ | Churchill | June 18, 1933 | Twomey | 105 | 74 | 30 | 12 | gray breeding plumage |
| | | | LABRADOR | | | | | | | |
| Nat. Mus. | 10872 | ♂ | Groswater Bay | July .. .. | Carees | 102–4 | 66 | 32 | 13 | gray breeding plumage |
| M. C. Z. | 45826 | ♂ | Groswater Bay | July 24 .. | Bryant | 104 | 72 | 32 | 14 | gray breeding plumage |
| Bent | 3741 | ♀ | Eskimaux Point | June 13, 1909 | Townsend | 101 | 72 | 31 | 11 | migration color |
| M. C. Z. | 15929 | ♂ | Assizes Harbor | July 17, 1900 | Bigelow | 98 | 67 | 32 | 13 | gray, turning brownish |
| | 140396 | ♂ | Nain | Aug. 8, 1928 | Austin | 102 | 70 | 32.5 | 13 | juvenile plumage |
| Nat. Mus. | 94286 | .. | Davis Inlet | June 28, 1883 | Turner | 105 | 71 | 31 | 14 | not especially gray |
| M. C. Z. | 140397 | ♀ im. | Mannocks Is. | July 21, 1928 | Austin | 95 | 64 | 30 | 15 | gray breeding plumage |
| | 140399 | ♀ juv. | Makkovik | Aug. 15, 1928 | Austin | 94–5 | 68 | 31 | 14.5 | juvenile plumage |

## MEASUREMENTS OF NEWFOUNDLAND GRAY-CHEEKED THRUSHES FROM BREEDING RANGE

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| Batchelder | 3648 | ♂ | Curslett | June 18, 1889 | Cahoon | 102–3 | 71.5 | 30.5 | 13 | Brownish Olive |
| | 3657 | ♀ | Curslett | June 18, 1889 | Cahoon | 95 (fr.) | 64 | 28.5 | 12 | Olive-Brown |
| | 3649 | ♂ | Curslett | June 19, 1889 | Cahoon | 105 | 75 | 33 | 12 | Olive-Brown |
| | 3650 | ♂ | Curslett | June 19, 1889 | Cahoon | 104 | 72.5 | 32 | 13 | Olive-Brown |
| | 3651 | ♂ | Curslett | June 24, 1889 | Cahoon | 100 | 69 | 32 | 13 | Olive-Brown |
| | 3652 | ♂ | Curslett | June 27, 1889 | Cahoon | 104 | 68 | 30 | 12 | Brownish Olive |
| | 3653 | ♂ | Curslett | June 28, 1889 | Cahoon | 104–5 | 72.5 | 31 | 14 | Olive-Brown |
| | 3658 | ♀ | Curslett | July 1, 1889 | Cahoon | 100 (fr.) | 71 (fr.) | 31 | 13 | Olive-Brown |
| | 3659 | ♀ | Curslett | July 1, 1889 | Cahoon | 100 | 70 | 32 | 12 | Brownish Olive |
| | 3660 | ♀ | Curslett | July 1, 1889 | Cahoon | 98 (fr.) | 68 (fr.) | 29 | 13 | Olive-Brown |
| | 3661 | ♀ | Curslett | July 4, 1889 | Cahoon | 97 (fr.) | 65 (fr.) | 32 | 11.5 | Olive-Brown |
| | 3654 | ♂ | Curslett | July 5, 1889 | Cahoon | 98.5 | 67 | 33 | 13 | Brownish Olive |
| | 3662 | ♀ | Curslett | July 5, 1889 | Cahoon | 100 (fr.) | 72 | 31 | 12 | Brownish Olive |
| | 3655 | ♂ | Curslett | July 8, 1889 | Cahoon | 103 | 73 | 29 | 13.5 | Olive-Brown |
| | 3656 | ♂ | Curslett | July 8, 1889 | Cahoon | 104 | 66 | 31 | 12 | Olive-Brown |
| | 5432 | – | Custlett | June 12, 1890 | Cahoon | 100 | 66 | 31 | 13 | especially brown, Sepia |
| | 5433 | – | Custlett | June 12, 1890 | Cahoon | 103 | 72 | 31 | 12.5 | like northern gray-cheek plumage |
| | 5434 | – | Custlett | June 12, 1890 | Cahoon | 96–7 (♀) | 66 | 31 | 12 | Olive-Brown |
| | 5435 | – | Custlett | June 12, 1890 | Cahoon | 104 | 75 | 32 | 14 | especially brown, Sepia |
| | 5422 | ♂ | Custlett | June 14, 1890 | Cahoon | 104 (fr.) | 70 | 32 | 12.5 | Brownish Olive |
| | 5423 | ♂ | Custlett | June 14, 1890 | Cahoon | 108 | 72 | 30 | 13 | like northern gray-cheek plumage |
| | 5424 | ♂ | Custlett | June 14, 1890 | Cahoon | 105 | 77 | 31 | 13 | Olive-Brown to Sepia |
| | 5425 | ♂ | Custlett | June 14, 1890 | Cahoon | 105–6 | 74 | 32 | 14 | especially brown, Sepia |
| | 5429 | ♀ | Custlett | June 14, 1890 | Cahoon | 100 | 69 | 31 | 14 | Olive-Brown |
| | 5426 | ♂ | Custlett | June 16, 1890 | Cahoon | 101 | 71 | 33.5 | 13 | Olive-Brown |
| | 5427 | ♂ | Custlett | June 23, 1890 | Cahoon | 104 | 76 | 32 | 12 | Brownish Olive |
| M. C. Z. | 170496 | ♀ | Custlett | July 3, 1890 | Bigelow | 95–6 | 69 | 29 | 12 | Olive-Brown |
| Thayer | 25575 | ♀ | Nicholsville | July 8, 1915 | Noble | 97 | 66 | 29.5 | 13 | Olive-Brown |
| Bent | 10299 | ♀ | Grand Lake | June 26, 1919 | Whitaker | 97–9 | 67.5 | 30 | 14.5 | intermediate—brown, shot at nest |
| Batchelder | 3643 | ♂ | Placentia | June 3, 1889 | .... | 99–100 | 66 | 32 | 12 | Olive-Brown |
| | 3644 | ♂ | Placentia | June 5, 1889 | .... | 101 | 70 | 33 | 12.5 | Olive-Brown |
| | 3645 | ♂ | Placentia | June 5, 1889 | Cahoon | 105 | 72 | 31 | 14 | Olive-Brown |
| | 3646 | ♂ | Placentia | June 6, 1889 | Cahoon | 99 | 68 | 30 | 12 | Olive-Brown |
| | 3647 | ♀ | Placentia | June 6, 1889 | Cahoon | 96 | 63 | 33 | 12.5 | Olive-Brown |
| | 5421 | ♂ | Placentia | June 2, 1890 | Cahoon | 103–4 | 76 | 33 | 13 | Olive-Brown |
| | 6795 | ♂ | near Deer Pond | June 26, 1894 | Colburn | 104 | 73.5 | 32 | 13.5 | Olive-Brown |
| | 6796 | ♂ | Deer Pond | July 2, 1894 | .... | 102 | 73 | 32 | 13 | Olive-Brown |
| | 5428 | ♂ | Exploits Bay | July 29, 1890 | Cahoon | 104 | 71 | 31 | 13 | Olive-Brown |
| | 5431 | ♀ | Exploits Bay | July 29, 1890 | Cahoon | 98 | 67 | 31 | 13 | Brownish Olive |
| | 3663 | – juv. | Bay of Islands | Aug. 2, 1889 | Cahoon | 100 | 69 | 31.5 | 12 | juvenile plumage |
| | 6797 | ♂ | Blowme Downs | July 9, 1894 | Colburn & Potter | 101 | 71 | 31 | 13 | Brownish Olive |
| | 6953 | ♀ | Bay St. George | June 4, 1896 | Doane | 105–8 (♂) | 77 | 31 | 13 | "color appr. bicknelli" (on label) |
| | 6954 | ♀ | Bay St. George | June 11, 1896 | Doane | 101.5 | 67 | 32 | 13.5 | "color appr. bicknelli" (on label) |
| | 6955 | ♀ | Bay St. George | June 11, 1896 | Doane | 98–9 | 71 | 30 | 13 | "color appr. bicknelli" (on label) |
| | 6957 | ♀ | Bay St. George | June 29, 1896 | Doane | 100 | 71 | 32 | 13 | "color appr. bicknelli" (on label) |
| | 6958 | ♀ | Bay St. George | July 23, 1896 | Doane | 99 | 68 | 31 | 13.5 | "color appr. bicknelli" (on label) |
| Vict. Mem. M. | 8298 | ♂ ad. | Perce, Gaspé | June 14, 1915 | Young | 100 | 69 | 31 | 13 | Olive-Brown |

## PROBABLE MIGRATION RECORDS FOR NEWFOUNDLAND GRAY-CHEEKS*

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| M. C. Z. | 10862 | ♂ | Pt. Lepreaux, N. B. | Sept. 17, 1885 | Brewster | 99 | 67 | 33 | 11 | dark bright brown |
| Thayer | 24738 | ♂ | Shelburne, N. H. | Sept. 23, 1884 | Chadbourne | 100–2 | 69 | 31 | 13 | brown |
| Nat. Mus. | 116920 | ♂ | Cambridge, Mass. | Sept. 30, 1871 | Henshaw | 104–5 | 74 | 34 | 13.5 | brown |
| M. C. Z. | 25137 | ♂ | Cambridge, Mass. | Sept. 24, 1888 | W. Brown | 99 | 70 | 31 | 11 | very brown |
| | 249123 | ♂ | W. Newton, Mass. | Oct. 3, 1875 | Purdie | 99–100 | 70 | 30 | 12 | brown |
| Bost. Soc. | 249124 | ♂ | W. Newton, Mass. | Sept. 30, 1878 | Purdie | 101–2 | 72 | 31.5 | 13 | brown |
| M. C. Z. | 2008 | ♂ | W. Quincy, Mass. | May 18, 1900 | Nelson | 103 | 72 | 28 | 11 | very brown |
| Bent | 6138 | ♂ | Taunton, Mass. | Sept. 28, 1899 | .... | 101 | 68.5 | 30 | 13 | |
| Nat. Mus. | 63064 | ♂ | .... , Mass. | .. .. .... | Henshaw | 97 | 70 | 30.5 | 13 | brown |
| Nat. Mus. | 234462 | ♂ ad. | Highland Falls, N. Y. | May 26, 1882 | Mearns | 103 | 72.5 | 31 | 12.5 | brown |
| Thayer | 38460 | ♀ | Pocantico, N. Y. | May 22, 1891 | Scott | 98–9 | 66 | 31 | 12 | very brown |
| | 38462 | ♂ | Pocantico, N. Y. | May 16, 1892 | Scott | 105–7 | 70 | 31 | 12 | very brown |
| A. M. N. H. | 66567 | ♀ | Fire Is. Light, N. Y. | Sept. 23, 1887 | Dutcher | 97 | 59 | 29 | .. | brown |
| U. M. M. Z. | 75231 | ♂ | South Orange, N. J. | Oct. 1, 1896 | Scott | 109 | 65 | 30 | 14 | brown |
| | 75230 | ♀ | South Orange, N. J. | Oct. 3, 1896 | Scott | 101 | 67 | 30 | 13.5 | brown |
| | 75232 | ♂ | South Orange, N. J. | Oct. 20, 1896 | Scott | 108 | 69 | 29 | 13.5 | brown |
| P. M. Z. | 501 | ♂ im. | Princeton, N. J. | Sept. 26, 1878 | Scott | 102 | .. | .. | .. | brown |
| | 457 | ♂ im. | Princeton, N. J. | Oct. 7, 1879 | Scott | 100.5 | .. | .. | .. | brown |
| Nat. Mus. | 275191 | ♂ | Baltimore, Md. | May 27, 1884 | Jennings | 104 | 72 | 31 | 14 | intermediate |
| | 275192 | ♂ im. | Baltimore, Md. | Oct. 11, 1884 | Jennings | 102 | 67.5 | 31.5 | 13 | brown |
| | 175841 | ♀ | Laurel, Md. | Sept. 24, 1889 | Ridgway | 97 | 67.5 | 29 | 13 | brown |
| | 295834 | ♀ | Kensington, Md. | Sept. 29, 1895 | Palmer | 98–9 | 62.5 | 30 | 13 | brown |
| | 295835 | ♂ | Kensington, Md. | Sept. 30, 1895 | Palmer | 104 | 71 | 32 | 13 | brown |
| Nat. Mus. | 295826 | ♂ | Rock Creek, D. C. | Oct. 12, 1889 | Palmer ? | 107.5 | 67 | 31 | 12.5 | dark brown |
| | 124268 | ♂ | Washington, D. C. | Oct. 3, 1885 | Richmond | 99–100 | 67 | 29 | 13 | brown |
| Thayer | 12282 | ♂ | Washington, D. C. | May 8, 1888 | Fisher | 102–3 | 73 | 30 | 13 | brown |
| | 12288 | ♂ | Washington, D. C. | May 8, 1888 | Fisher | 99 | 69.5 | 30 | 12 | brown |
| | 12290 | ♀ | Washington, D. C. | May 27, 1888 | Fisher | 97–7.5 | 67 | 30 | 12 | intermediate—brown |
| Nat. Mus. | 295833 | ♂ im. | Smiths Is., Va. | May 22, 1898 | Palmer | 102 | 72 | 31 | 13 | brown |
| M. C. Z. | 19616 | ♂ | Buncombe Co., N. C. | ?July 16, 1886 | Cairns | 100 | 64 (fr.) | 30 | 11.5 | brownish or intermediate |

*It must be acknowledged that these specimens were more or less arbitrarily picked out of various collections and assumed to be Newfoundland migrants because their brown-backed appearance would hardly permit any other conclusion. Considering the variability of migrants of the northern gray-cheek, however, it is not improbable that this list may include a few aberrant specimens of that form.

## WINTER RECORDS FOR NEWFOUNDLAND GRAY-CHEEKS*

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| A. M. N. H. | 70424 | .. | Bonda, Colombia | Nov. 11, 1898 | Jesup | 100 | 62 | 31.5 | .. | |
| | 72229 | .. | Valparaiso, Colombia | Mar. 18, 1899 | Jesup | 99 | 68 | 31 | .. | |
| | 72230 | .. | Valparaiso, Colombia | Mar. 23, 1899 | Jesup | 96 | 63 | 29 | .. | |
| | 70421 | | Onaca, Colombia | Dec. 26, 1898 | Jesup | 96 | 61 | 30 | .. | |
| | 97614 | .. | Onaca, Colombia | Dec. 28, 1898 | Jesup | 97–9 | 65 | 29.5 | .. | |
| Nat. Mus. | 163319 | ♂ | Santa Marta Mts., Colombia | Jan. 29, 1898 | W. W. Brown | 101–3 | 71 | 32 | .. | |
| M. C. Z. | 5847 | ♂ | Santa Marta Mts., Colombia | Feb. 8, 1898 | W. W. Brown | 104 | 73 | 30 | .. | (Bangs collection) |

*Records thus based on unsexed and rather faded specimens are by no means conclusive.

## ACCIDENTAL RECORDS FOR NEWFOUNDLAND GRAY-CHEEKS

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| U. M. M. Z. | 31361 | ♂ | Ann Arbor (Campus) Michigan | Sept. 21, 1903 | Mast | 98 | 62 | 29 | (broken) | brownish |
| Chic. A. S. | 1459 | ♀ juv. ? | Evanston, Ill. | Aug. 27, 1898 | .. | 96 | 67.5 | 26 | 13 | light brown |
| | 1480 | ♀ | Wilmette, Ill. | Sept. 2, 1898 | .. | 96 | 65 | 29.5 | 13 | (melanistic) |
| Nat. Mus. | 82517 | ♀ | Columbus, Ohio | .. .. 1873 | .. | 96–6.5 | 62.5 | 28.5 | 12 | light brown |

## LOCALITY RECORDS FOR BICKNELL'S THRUSH

### BREEDING RANGE

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | ST. LAWRENCE REGION | | | | | | | |
| .... | 1192 | ♀ | Cape Charles, Labr. | July 28, 1906 | Townsend | 95 (fr.) | 67 | 28 | 13 | olive* |
| .... | 1448 | ♀ | Grand Romaine, Labr. | July 8, 1915 | Townsend | 90 (fr.) | 62 | 28 | 13 | olive |
| Carn. Mus. | 57400 | ♂ | Gr. Portage, Labr. | June 14, 1917 | J. G. M. | 96 | 71 | 28 | .. | olive |
| | 102637 | ♂ | Little Mecatina R., Que. | June 27, 1928 | Sutton | 94 | 71 | 29 | .. | olive |
| | 102539 | ♂ | Pt. Natashquan, Que. | June 2, 1928 | Sutton | 97 | 70 | 28.5 | .. | olive |
| | 9479 | ♂ | Magdalen Is. | June 27, 1901 | Todd | 92 | 67 | 29.5 | .. | olive |
| | 9480 | ♂ | Magdalen Is. | June 28, 1901 | Todd | 96 | 70 | 29 | .. | olive |
| Nat. Mus. | 115026 | – | Grindstone Is. | July 15, 1887 | Bishop | 92–3 | 64 | 29 | 12 | olive, but faded |
| Vict. Mem. M. | 7522 | ♂ im? | Perce, Gaspé Co. | July 16, 1914 | Hennessey | 93 (fr.) | 65 | 30 | 12 | intermediate, inclining to brown |
| | 8284 | ♂ ad. | Perce, Gaspé Co. | June 4, 1915 | Johnson | 93 | 67 | 30 | 13 | intermediate, inclining to olive |

Other records:

Kegashka eastward, summer resident (Lewis).
La Tabatiere, Labr.; Monte St. Anne, Grand Greve; Gaspé, summer (Gillet 1935).
Perce, Gaspé, July 20, 1915, nest and eggs, (Taverner).
Skikshok Mts., Gaspé, (Wynne-Edwards).
Grand Valee, and "at the forks," July 8, (Demille 1926).

| | | | NOVA SCOTIA | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Bent | 6136 | ♀ | Seal Island | July 4, 1904 | Bent | 90 | 62 | 29 | 12.5 | olive |
| Bent | 6137 | ♀ | Seal Island | July 4, 1904 | Bent | 87 | 63 | 28 | 13 | olive |
| M. C. Z. | 303199 | ♀ | Seal Island | June 29, 1906 | Tufts | 87.5–9 | 64 | 30 | 12 | olive |
| | 303200 | ♂ | Seal Island | June 29, 1906 | Tufts | 95–6 | 65 | 30 | 12 | olive |
| | 312304 | ♂ | Seal Island | June 13, 1907 | Tufts | 91–2 | 61 | 30 | 12 | olive |
| | 312305 | ♂ | Seal Island | June 13, 1907 | Tufts | 93 | 66 | 31 | 12 | olive |
| L. B. B. | 20558 | ♀ juv. | Seal Island | Aug. 21, 1901 | Bishop | 89 | 64 | .. | .. | brown juvenile plumage |
| M. C. Z. | 45834 | ♂ | Yarmouth | July 8, .. | Bryant | 96? | 69 | 30 | 12? | olive, rather faded |

Other records:

Seal Is., specimens and nests (Langille 1884); nest, June 3, 1901 (Meyer); summer resident, July 3–6, 1904 (Bent); resident (Job 1905); nests, June 8–14 (Tufts).
West Cape, Yarmouth (C. Allen 1916; Lewis 1920).
Mud Is., rare, June 7, 1907 (Tufts).

*The term olive is arbitrarily chosen to designate the northern phase in distinction from the brown Catskill type. Specimens of doubtful color phase are lumped as intermediates, some of which probably represent true intergrades, others probably merely the intermediate extremes of one or the other color phase. It should also be acknowledged that many of the specimens, especially the migrants, were necessarily hastily examined and a quick and probably often erroneous decision made as to their proper coloration. Nevertheless, though the writer has frequently wavered in his determination to publish such color notes, he is confident that their general purpose is a useful one in spite of unavoidable errors.

## BREEDING RANGE

(continued)

| Collection | No. | Sex | Locality | Date | Collector | Wing mm. | Tail mm. | Tarsus mm. | Bill mm. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MAINE | | | | | | | |
| No specimen records. Other records are: | | | | | | | | | | |
| Mt. Katahdin, song, June 23, 1897 (F. H. Allen 1898) observed (Gross). | | | | | | | | | | |
| Mt. Abraham, song, June 22, 1906 (Sweet 1906). | | | | | | | | | | |
| Mt. Bigelow, observed July 13, 1921 (Perkins 1922) | | | | | | | | | | |
| | | | NEW HAMPSHIRE | | | | | | | |
| | | | | | | | | | | (Figured by Forbush) |
| M. C. Z. | 7389* | ♂ | Mt. Washington | July 20, 1882 | Brewster | 95–6 | 66 | 30 | 12 | olive, with brown wings and tail |
| | 7390* | ♂ im. | Mt. Washington | July 20, 1882 | Brewster | 91 | 64.5 | 30 | 13 | olive |
| Bost. Soc. | 9320* | ♂ | Mt. Washington | July 11, 1884 | Brewster | 93–4 | 68 | 32.5 | 14 | brown |
| Thayer | 24734 | ♀ | Mt. Washington | July 11, 1884 | Chadbourne | 100–1 | 65 | 30 | 13 | dark brown |
| | 24735 | ♂ | Mt. Washington | July 11, 1884 | Chadbourne | 91 | 66 | 29 | 12 | brown |
| | 24736 | ♂ | Mt. Washington | July 11, 1884 | Chadbourne | 89 | 64 | 29 | 13.5 | brown |
| | 24737 | ♀ | Mt. Washington | July 11, 1884 | Chadbourne | 93 | 66 | 31 | 12 | faded brown |
| M. C. Z. | 9323* | ♂ | Mt. Washington | July 12, 1884 | Brewster | 89–91 (fr.) | 64 | 29 | 13.5 | olive |
| | 9324* | ♀ | Mt. Washington | July 12, 1884 | Brewster | 90 | 66 | 29 | 13 | olive, with brown wings and tail |
| Bost. Soc. | 9325* | ♂ | Mt. Washington | July 12, 1884 | Brewster | 67 | 24.5 | 28 | 10 | juvenile plumage |
| | Mount | ♂ im. | Carter's Notch | Sept. 5, 1899 | Howe | 88–90 | 63 | 30 | 11.5 | brown |
| | 2212 | ♂ | Carter's Notch | June 14, 1902 | Howe | 90 | 60.5 | 31 | 13 | intermediate |
| A. N. S. | 37859 | ♂ | Carter's Dome | July 1, 1896 | Van der Wielen | 94 | 68 | 30.5 | 12.5 | intermediate |
| | 37860 | ♂ | Carter's Dome | July 2, 1896 | Van der Wielen | 89–91 | 68 | 29 | 12.5 | intermediate |
| Bost. Soc. | 30677 | ♀ | Mt. Moosilauke | June 22, 1894 | Brewster | 85 | 60 | 30 | 14 | brown ("Parent of nest and eggs A/3") |
| McK. | .. | ♀ im. | Mt. Madison | June 25, 1908 | McKechnie | 81 | 55 (fr. ?) | 30 | 13 | intermediate ("Breeding—shot at the nest") |

Other records:
Mt. Washington, June 14—Sept. 10, 1930. E. G. Loomis, Jr. (Biological Survey records).
Mt. Madison, June 22, 1904, nest (Spaulding 1905).
Mt. Adams, June 17, 1905, nest (Childs 1905).
Mt. Cannon, heard (Faxon and Allen 1888); June 29, 1912. (Corey 1913).
Mt. Lafayette, resident (Faxon and Allen 1888).
Mt. Pemigewasset, (Corey 1913).
Lost River, summer resident, nest (Gross).
Tripyramid, Black Mt., Osceola, Tecumseh, Mt. Chocorua, Moat Mt., Carter Mt., (G. M. Allen 1902).
Canadian Lakes (-Connecticut Lakes?) nest (Biol. Sur. records).
Mt. Monadnock, (Gillet, 1935).

*Brewster numbers, not M. C. Z. or Bost. Soc.

## BREEDING RANGE

(continued)

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | VERMONT | | | | | | | |
| M. C. Z. | 6859 | ♀? | Mt. Mansfield | July 2, 1895 | Batchelder | 84–5 (fr.) | 59 | 31 | 12 | olive with brown wings and tail |
| | 6860 | ♀ | Mt. Mansfield | July 3, 1895 | Batchelder | 84 | 61 | 29 | 12 | brown |
| | 10145 | ♂ | Mt. Mansfield | July 26, 1885 | Torrey | 82 | 54 | 30 | 13 | juvenile plumage |
| Biol. Sur. | 1064* | ♀ | Mt. Mansfield | June 22, 1899 | Howell | 95 | 67 | 30 | 13 | very brown |
| | 1065* | ♂ | Mt. Mansfield | June 23, 1899 | Howell | 95 | 64 | 30 | 13 | intermediate in direction of brown |
| | 1112* | ♂ | Mt. Mansfield | July 2, 1900 | Howell | 93.5 | 65 | 29 | 13 | olive |
| | 338728 | ♂ | Mt. Mansfield | June 21, 1933 | Burleigh | 94 | 68 | 31 | 13.5 | olive |
| | 338729 | ♂ | Mt. Mansfield | June 21, 1933 | Burleigh | 90 | 60 | 29 | 13 | intermediate in direction of olive |
| G. J. W. | .... | ♀ | Mt. Mansfield | July 10, 1935 | Wallace | 84 | 59 | 30.5 | 13.5 | olive |
| | .... | juv. | Mt. Mansfield | July 31, 1935 | Wallace | 78 | 50 | 29 | 13 | juvenile plumage, 29 days old |
| | .... | ♀ | Mt. Mansfield | Aug. 13, 1935 | Wallace | 91 | 64.5 | 29.5 | 14 | olive |
| | .... | juv. | Mt. Mansfield | Aug. 30, 1935 | Wallace | 91 | 63 | 29 | 14 | olive, 37 days old |
| | .... | ♂ im. | Mt. Mansfield | Sept. 6, 1935 | Wallace | 92 | 66 | 30 | 12 | olive |
| | .... | ♂ | Mt. Mansfield | Sept. 8, 1935 | Wallace | 95 | 68 | 30.5 | 12.5 | olive |
| | .... | ♀ im. | Mt. Mansfield | Sept. 9, 1935 | Wallace | 84 | 50 | 29 | 13 | olive |
| J. L. P. | 3311 | ♀ im. | Killington | July 2, 1924 | Peters | 87 | 60 | 29 | 12 | intermediate |
| | 3563 | ♂ | Killington | June 19, 1929 | Peters | 93–4 | 65 | 30 | 12 | intermediate |

Other records:

Mt. Mansfield, observations (Torrey 1889; Howell 1901; Davenport 1903; Hoffman 1904; Whittle 1920; Mathews 1921; and others.)
Mt. Killington, specimens (G. H. Ross and Sheldon; Kirk). Eggs (Kent); song (F. H. Allen 1908); observations (L. Ross 1924; Eaton and Curry 1926).
Mts. Pico, Carmel and Horrid (G. H. Ross).
?Mt. Annanance (Howe 1902).
Couching Lion, 18 pairs (Vt. Bird Club Census 1933); observed (L. Ross 1924; Eaton and Curry 1926; Peters; Wallace.).
Mt. Stratton and Woodford (L. Ross 1924).
Other peaks from Eaton and Curry (1926): Bromley, Lincoln, Theodore Roosevelt, Bolton.
Jay Peak? (Howe 1902).
Bolton, Dewey, Sterling, Elephant's Head (Wallace).

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | NEW YORK | | | | | | | |
| C. F. B. | 3019 | – | Keene, Essex Co. | July 31, 1889 | Batchelder | 80–1 | 41 | 27 | 10 | juvenile plumage |
| Nat. Mus. | 95545 | ♂ | Slide Mt. | June 15, 1881 | Bicknell | 93 | 66 | 28 | 12 | brown, type specimen of *bicknelli* |
| N. Y. S. M. | 999 | ♂ | Catskill Mts. | Aug. 7, 1899 | Braislin? | 96 | 65 | 27 | 12 | brown |

Other records:

Slide Mt. 2 additional specimens (Bicknell 1881, 1882); 2 specimens (J. A. Weber); nest (Gillet 1935); breeding (Daley 1922); song (Burroughs 1895).
Wittenberg, song (Gillet 1935).
Mt. Marcy and vicinity, summer resident, specimen July 18 (Eaton 1910); song, juv. specimen by Dr. Harper (Saunders 1929); breeding (Weyl 1927).
Mt. McIntyre (Saunders 1929).
Giant Mt. (Weyl 1927).

*Howell numbers, not Biological Survey.

## BREEDING RANGE

(continued)

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MASSACHUSETTS | | | | | | | |
| M. C. Z. | 245796 | ♂ im. | Mt. Greylock | July 6, 1888 | Faxon | 89 | 64 | 29 | 13.5 | brown "shot singing" |

Other records:

Mt. Greylock: June 29–30, 1895 and June 18–19, 1896 (Faxon 1895; Faxon and Allen 1900).
June 18, 1902 (R. H. Howe Jr. 1902).
May 28–30, 1910, 12 pairs (Maynard 1910).
June 8–9, 1911, several (Jenney 1911).

Williamstown: June 11, 12 and 18, 1913; June 11 and 12, 1914 Brainard (Survey Records).

## MIGRATION RECORDS

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MAINE | | | | | | | |
| Bost. Soc. | 469 | ♀ | Oxford Co. | June 3, 1872 | Brewster | 93–7 | 65 | 31 | 14 | olive |
| P. M. Z. | 6955 | ♂ | Deering Co. | May 17, 1876 | N. C. Brown | 96 | | | | (measured by C. H. Rogers) |

Other records:

Cumberland Co., Sept. 30, 1878, specimen Portland Soc. of Nat. Hist. (Norton 1909).

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MASSACHUSETTS | | | | | | | |
| Nat. Mus. | 63064 | ♂ | .... | .... | Henshaw | 97 | 70 | 30.5 | 13 | |
| M. C. Z. | 474 | ♂ | Grantville | May 30, 1872 | .... | 90 | 64 | 29 | 13 | brownish |
| Nat. Mus. | 86660 | ♂ | Grantville | May 20, 1873 | Roosevelt | 93 | 62.5 | 29 | 12 | brown |
| M. C. Z. | 477 | ♀ juv. | Cambridge | Sept. 26, 1870 | Brewster | 87 | 61 | 28.5 | 13 | brown |
| Batchelder | 3018 | – | Cambridge | Sept. 30, 1889 | Faxon? | 87–8(fr.) | 61 (fr.) | 30 | 12 | brown |
| Bost. Soc. | 29832 | ♂ im. | Cambridge | Sept. 30, 1891 | Brown | 95 | 65 | 30.5 | 11.5 | intermediate |
| M. C. Z. | 47766 | ♂ | W. Newton | Oct. 12, 1880 | Purdie | 94 | 66 | 31 | 13.5 | brown |
| | 471 | ♂? | Nantucket | Sept. 27, 1878 | Brewster | 95–6 | 62 | 28 | 11 | olive |
| | 472 | ♀ | Nantucket | Sept. 27, 1878 | Brewster | 92 | 62 | 25 | 11 | intermediate—olive |
| | 10122 | ♂ | Dedham | Oct. 4, 1883 | Wakefield | 95 | 63.5 | 31 | 13.5 | brown |
| McK. | .... | ♀ | Dedham | May 26, 1902 | Browne | 93 | 64 | 30.5 | 13 | olive |
| M. C. Z. | 4735 | ♂ juv. | Concord | Oct. 4, 1879 | Brewster | 96 | 65 | 29 | 14 | olive |
| Bent | 3787 | ♂ | Westport | Sept. 18, 1909 | .... | 95 | 61 | 31 | 12 | olive |
| Bost. Soc. | 828 | ♂ | Brookline | Oct. 16, 1898 | Shattuck | 88.5 | 62 | 31 | 14 | brown |

## MIGRATION RECORDS

(continued)

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MASSACHUSETTS (continued) | | | | | | | |
| Bost. Soc. | 7606 | ♀ | Middlesex Co. (Belmont) | May 30, 1882 | Maynard | 94 | 61 | 30.5 | 13 | brown |
| | 25092 | ♀ | Belmont | Sept. 29, 1883 | Lamb | 81–5 | 60 | 29 | 13 | brown |
| Thayer | 24739 | ♂ im. | Middlexex Co. | Oct. 5, 1883 | Chadbourne | 91.5 | 63.5 | 31 | 11 | bright brown |
| | 11544 | ♂ | Middlesex Co. | May 24, 1886 | Brewster | 94 | 70 | 29 | 12 | brown |
| Bost. Soc. | 13862 | ♀ | Wellesley Hills | Oct. 5, 1885 | Brewster | 92 | 65.5 | 30 | 12 | intermediate—brown |
| | 1257 | ♀ | Boston | June 11, 1907 | Townsend | 88 | 57 | 30 | 12 | brown |
| Other records: | | | | | | | | | | |
| Salem, Sept. 30, 1932, specimen, Peabody Museum (Emilio 1932). | | | | | | | | | | |
| Boston (Wright 1909). | | | | | | | | | | |
| | | | CONNECTICUT | | | | | | | |
| Bost. Soc. | 42124 | ♀ | New Haven | May 17, 1890 | Flint | 94 | 67 | 31 | 13 | olive |
| Dwight | 33559 | ♂ | New Haven | May 21, 1894 | Flint | 93–4 | 66 | 29 | .. | olive |
| L. B. B. | 2281 | ♂ ad. | New Haven | Oct. 3, 1895 | A. H. V. | 95–7 | 65 | .. | .. | |
| | 7315 | ♀ ad. | New Haven | May 22, 1902 | Bishop | 91 | 63 | .. | .. | |
| | 9619 | ♀ juv. | New Haven | Sept. 30, 1903 | Bishop | 94 | 60 | .. | .. | |
| | 9647 | ♂ ad. | New Haven | Oct. 3, 1903 | Bishop | 95–6 | 74.5* | .. | .. | |
| | 11447 | ♂ juv. | New Haven | Oct. 1, 1904 | Bishop | 89 | 61 | .. | .. | |
| | 16642 | ♂ juv. | New Haven | Oct. 9, 1906 | Bishop | 90 | 62 | .. | .. | |
| | 23571 | ♂ juv. | New Haven | Oct. 9, 1911 | Bishop | 91 | 66 | .. | .. | |
| | 25088 | ♂ juv. | East Haven | Oct. 24, 1895 | Flint | 92 | 65 | .. | .. | |
| | 4948 | ♂ ad. | East Haven | May 16, 1900 | Bishop | 94 | 68 | .. | .. | |
| | 11297 | ♀ juv. | East Haven | Sept. 21, 1904 | Bishop | 90–1 | 62.5 | .. | .. | |
| | 14287 | ♀ juv. | East Haven | Sept. 27, 1905 | Bishop | 93 | 62.5 | .. | .. | |
| | 18408 | ♀ juv. | East Haven | Oct. 5, 1907 | Bishop | 86 | 58.5 | .. | .. | |
| | 28522 | ♂ ad. | West Haven | May 27, 1916 | Bishop | 93 | 67 | .. | .. | |
| | 18816 | ♂ ad. | North Haven | May 15, 1908 | Bishop | 93–4 | 66 | .. | .. | |
| | 17680 | ♂ ad. | Orange | May 15, 1907 | Bishop | 92 | 66 | .. | .. | |
| | 27489 | ♀? | Easton | Oct. 12, 1912 | Hastings | 85 | 57 | .. | .. | |
| Dwight | 23401 | ♂ | Danbury | Oct. 3, 1907 | Meeker | 90 | 63 | 30 | .. | brown |
| Other records: | | | | | | | | | | |
| New Haven, Oct. 11, 1906, Woodruff. | | | | | | | | | | |
| P. M. N. H. 3317 ♂ ad. New Haven, Oct. 9, 1919 Harrison. | | | | | | | | | | |
| P. M. N. H. 9975 ♂ mount New Haven Oct. 1, 1930 James. | | | | | | | | | | |
| P. M. N. H. 3299 ♂ Easton Sept. 12, 1908 Beers. | | | | | | | | | | |
| Easton, Oct. 3, 1908 Beers. | | | | | | | | | | |
| Stamford, ♂, Sept. 23, 1893 (Howes 1928). | | | | | | | | | | |

*One tail feather abnormally long, otherwise 70 mm.

## MIGRATION RECORDS

(continued)

| Collection | No. | Sex | Locality | Date | Collector | Wing mm. | Tail mm. | Tarsus mm. | Bill mm. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | RHODE ISLAND | | | | | | | |
| Smith, ♂, Warwick, Oct. 9, 1898 (Howe and Sturtevant 1899). | | | | | | | | | | |
| | | | NEW YORK | | | | | | | |
| Nat. Mus. | 95546 | ♀ im. | Riverdale | Oct. 8, 1881 | Bicknell | 83.5–84 | 58 | 30 | .. | brown—intermediate |
| A. M. N. H. | 98695 | ♂ | Statue of Liberty | Sept. 18–19, 1899 | Foster | 94 | 59 | 30 | .. | brown |
| | 98696 | ♂ | Statue of Liberty | Oct. 11–12, 1891 | Foster | 87 | 60.5 | 29 | .. | brown |
| | 98697 | ♂ im. | Statue of Liberty | Oct. 11–12, 1891 | Foster | 95 | 64 | 29 | .. | brown |
| | 48324 | ♂ | Shelter Is. | May 21, 1886 | Worthington | 94.5–6 | 60 | 31 | .. | brown |
| Brook. M. | 10687 | ♂ | Brooklyn | Sept. 28, 1912 | .... | 96 | 61.5 | 31 | .. | brown |
| Thayer | 12292 | ♂ | Sing Sing | May 19, 1879 | Fisher | 94 | 69 | 32 | 13.5 | olive |
| | 12284 | ♂ | Sing Sing | Sept. 24, 1879 | Fisher | 97 | 66 | 30 | 12 | olive |
| C. H. M. | 1873 | ♂ im. | Lewis Co. | May 24, 1878 | Merriam | 92.25 | 70 | .. | .. | .... |
| A. M. N. H. | 66565 | – | Fire Is. Light | Sept. 23, 1887 | Dutcher | 93 | 55 | 28.5 | .. | olive |
| Dwight | 2724 | ♂ ad. | Van Cortlandt, N. Y. C. | May 12, 1890 | Dwight | 94 | 68 | 31 | .. | brown |
| A. M. N. H. | 66563 | ♂ | Shinnecock Light, L. I. | Oct. 1, 1881 | Dutcher | 97 | 61 | 29 | .. | brown |
| | 66564 | ♂ | Shinnecock Light, L. I. | Oct. 1, 1881 | Dutcher | 90 | 56.5 | 29 | .. | brown |
| Brook. M. | 979 | ♂ | Parkville, L. I. | Oct. 12, 1892 | Carson & Suydam | 91 | 56 | 31 | .. | brown |
| | 1114 | ♂? | Parkville, L. I. | Sept. 30, 1893 | Carson & Suydam | 92–3 | 65 | 30 | .. | very brown |
| Dwight | 47249 | ♀ | Parkville, L. I. | Oct. 3, 1894 | Braislin | 94.5 | 64.5 | 30.5 | .. | brown |
| Brook. M. | 6458 | ♂ | Rockaway Beach, L. I. | Oct. 5, 1889 | Howell | 86 | 55 | 29 | .. | brown |
| | 6459 | ♂ | Rockaway Beach, L. I. | Oct. 5, 1889 | Howell | 92–4 | 59 | 30 | .. | brown |
| | 1505 | ♂ | Jamaica, L. I. | May 22, 1900 | Cherrie | 94 | 65 | 29 | .. | intermediate to olive |
| N. Y. S. M. | 626/1907 | im. | Jamaica, L. I. | Sept. 17, 1900 | Braislin | 95 | 62 | 28 | 12 | intermediate |
| | 626/1908 | ad. | Jamaica, L. I. | Sept. 26, 1900 | Braislin | 95 | 68 | 31 | 12 | intermediate |
| Brook. M. | 5555 | – | Jamaica, L. I. | May 17, 1908 | .... | 92–3 | 66 | 30 | .. | brown |
| | 11862 | – | Bayport, L. I. | Oct. 10, 1902 | Shannon | 90? | 61.5 | 32 | .. | brown |

Other records:

Riverdale, May 24; Sept. 27, 29, and —(fall) 4 specimens, E. P. Bicknell.
Washington Co., Oct. 12, 1890 (Eaton 1910).
?Oneida Co., May 24, 1873 (Ralph and Bagg per Eaton 1910).
Fire Island Light, Sept. 23, and Oct. 11, 1887, 3 specimens Sanford collection.
New York City, Oct. 7, 1907 Lebuard. Sanford collection.
Astoria, Oct. 23, 1886, Dutcher (Howell 1893).
West Farms, May 16, 1887, Dwight, A. M. N. H. 376962 (not found).
Long Beach, Oct. 12, 1921, one found freshly killed (Griscom 1923).
Parkville, L. I., #980 mount, L. I. bird room, Oct. 12, 1892 Carson and Suydam.
Freeport, L. I., Oct. 12, 1913 Thurston specimen.

## MIGRATION RECORDS

(continued)

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | NEW JERSEY | | | | | | | |
| U. M. M. Z. | 75228 | ♀ im. | South Orange | Oct. 2, 1896 | Scott | 89 | 64 | 30 | 13 | brown |
| | 75229 | ♂ ad. | South Orange | Oct. 3, 1896 | Scott | 94–5 | 62 | 28 | 13 | brown |
| P. M. Z.* | 13427 | ♂ im. | South Orange | Oct. 3, 1896 | Scott | 92 | .. | .. | .. | .. |
| Fleming | 32314 | ♂ | South Orange | Oct. 15, 1896 | Scott | 93 | 64 | .. | .. | brown |
| P. M. Z. | 13410 | ♂ ad. | South Orange | Sept. 30, 1896 | Scott | 95 | .. | .. | .. | .. |
| | 13394 | ♂ ad. | South Orange | Sept. 29, 1896 | Scott | 91 | .. | .. | .. | .. |
| | 496 | ♂ ad. | Princeton | Oct. 7, 1879 | Scott | 94.5 | .. | .. | .. | .. |
| | 499 | ♂ ad. | Princeton | May 17, 1879 | Scott | 95 | .. | .. | .. | .. |
| F. M. N. H. | 70074 | ♀ | Princeton | May 24, 1879 | Scott | 92 | 65 | 30 | 13 | brown |
| P. M. Z. | 478 | ♂ im. | Princeton | Sept. 22, 1880 | Scott | 97 | .. | .. | .. | .. |
| | 490 | ♂ im. | Princeton | Sept. 24, 1880 | Scott | 97 | .. | .. | .. | .. |
| | .. | ♂ im. | Princeton | Oct. 4, 1924 | Rogers | 95 | .. | .. | .. | olive |
| M. C. Z. | 38593 | ♀ | .... | May 4, .. | Scott | 84.5 | 58 | 29 | 13 | olive |
| A. M. N. H. | 298216 | ♀ | Barnegat | Sept. 18, 1932 | .. | 94.5 | 63 | 28.5 | .. | olive (dark) |
| | 181131 | ♂ | (West?) Orange | Oct. 10, 1915? | Isham | 86.5 | 63 | 31 | .. | brown |
| No other records found. | | | | | | | | | | |
| | | | PENNSYLVANIA | | | | | | | |
| A. N. S. | 42867 | ♀ | West Chester | Sept. 30, 1896 | Garrett | | | | | |
| | 24794 | ♂ | Frankfort, Phil. | Oct. 16, 1878 | Rhoads | | | | | |
| | 29245 | .. | Chestnut Hills, Phil. | May 19, 1877 | Abbot | | | | | |
| | 65826 | ♂ | Kennett Square | May 20, 1909 | Pennock | | | | | |

Other records:

Stone 1849 Frankfort Sept. 30, 1879 S. N. Rhoads.
F. L. B. 1063 Berwyn, Chester Co. Oct. 6, 1915 F. L. Burns,
West Chester, 1893 J. Hooper (Burns 1919; Stone 1894). (Burns 1919).
Frankfort, Phil. Oct. 1878 several specimens, Wm. L. Collins. (Stone 1894).
?Chickies Rock, Lancaster Co., J. H. Roddy (Warren 1890).

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MARYLAND | | | | | | | |
| Nat. Mus. | 175843 | ♂ | Laurel | May 14, 1888 | Ridgway | 88 | 60 | 28 | 13 | brown |
| | 175844 | ♀ | Laurel | May 18, 1888 | Ridgway | 87–8 | 59.5 | 30 | 12.5 | intermediate |

Other records:

Laurel, May 14, 1888 Ridgway (a second specimen, not found at Nat. Mus.) (Cooke 1929). Baltimore (the two Jennings specimens in the Nat. Mus. are not Bicknell's).

* I am indebted to Mr. C. H. Rogers for measurements of specimens in the Princeton Museum.

## MIGRATION RECORDS

(continued)

| Collection | No. | Sex | Locality | Date | Collector | Wing mm. | Tail mm. | Tarsus mm. | Bill mm. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | DISTRICT OF COLUMBIA | | | | | | | |
| Nat. Mus. | 124267 | ♂ | Washington | Sept. 16, 1887 | Richmond | 93–4 | 60 | 28 | 11 | brown to intermediate |
| ?Thayer | 12303 | ♀ | Washington | May 17, 1892 | Fisher | 95–6 | 66 | 30.5 | 13 | faded brown |
| Biol. Sur. | 1119 | ♂ | Washington | May 16, 1901 | Howell | 92 | 64.5 | 30 | 12.5 | brown |
| Nat. Mus. | 295836 | ♂ | Rock Creek | May 8, 1886 | Palmer | 95 | 65 | 31 | 14 | brown |
| Other records: | | | | | | | | | | |
| Washington, Oct. 3, 1885 Richmond (Newfoundland gray-cheek). | | | | | | | | | | |
| Washington, May 24, 1893 Preble (Cooke 1921). | | | | | | | | | | |
| Washington, May 27, 1903 W. W. Cooke (M. T. Cooke 1929). | | | | | | | | | | |
| | | | VIRGINIA | | | | | | | |
| A. M. N. H. | 138963 | ♀ | Dismal Swamp | May 21, 1902 | Daniel Jr. | 90 | 60 | 31 | .. | faded brown |
| | 138964 | ♀ | Dismal Swamp | May 21, 1902 | Daniel Jr. | 88 | 59 | 30 | .. | brown—intermediate |
| Nat. Mus. | 236392 | ♂ im. | Falls Church | May 17, 1914 | Riley | 90 | 62.5 | 32 | 12 | brown |
| | | | NORTH CAROLINA | | | | | | | |
| M. C. Z. | 13798 | ♀ | Raleigh | May 5, 1887 | Brimley | 89–91 | 57.5 | 29 | 12 | brownish |
| | 25605 | ♀ im. | Raleigh | May 17, 1889 | Brimley | 86 | 56 | 29.5 | 12 | brownish |
| | 25604 | ♂ im. | Raleigh | May 18, 1889 | Brimley | 89 (fr.) | 61 | 31 | 14 | brownish |
| ? | 4827 | ♀ | Raleigh | May 3, 1894 | Brimley | 93.6 | 66.5 | .. | .. | measured by Brimley |
| M. C. Z. | 47542 | ♂ | Buncombe Co. | Sept. 22, 1894 | Cairns | 96 | 64 | 29 | 12 | brown |
| ? | 4031 | ♂ | Weaverville | Oct. 28, 1890* | Cairns | 95.3 | 69.9 | .. | .. | measured by Brimley |
| ? | 4032 | ♂ | Weaverville | Sept. 27, 1900* | Cairns | 92.1 | 66.7 | .. | .. | measured by Brimley |
| Other records: | | | | | | | | | | |
| Weaverville Sept. 11—Nov. 10 Cairns (no specimens for these dates) (Pearson 1919). | | | | | | | | | | |
| ?Black Mt. Aug. 1885 or 6 Cairns (see page 258). | | | | | | | | | | |
| ..... 2 specimens (mounted) Fairbanks Museum, St. Johnsbury, Vt. (Miss Mabel Shields). | | | | | | | | | | |
| | | | SOUTH CAROLINA | | | | | | | |
| M. C. Z. | 10371 | ♂ | near Charleston | May 2, 1885 | Brewster | 97 | 67.5 | 29.5 | 12 | brown |
| | 10496 | ♀ im. | near Charleston | May 15, 1885 | Brewster | 89 | 63.5 | 30 | 13 | brown |
| A. M. N. H. | 56122 | ♂ | Chester C. H. | May 6, 1887 | Loomis | 88 | 59.5 | 26 | .. | olive |
| | 56123 | ♀ | Chester C. H. | Sept. 17, 1887 | Loomis | 92–3 | 58 | 30.5 | .. | olive—intermediate |
| Other records: | | | | | | | | | | |
| Mt. Pleasant, May 10, 1900 specimen (Wayne 1910). | | | | | | | | | | |

*The Academy of Natural Sciences at Philadelphia has two specimens from Raleigh taken by Brimley that have these dates. Probably they are the same specimens mislabeled perhaps as a result of transfer.

## MIGRATION RECORDS

(continued)

| Collection | No. | Sex | Locality | Date | Collector | Wing mm. | Tail mm. | Tarsus mm. | Bill mm. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | GEORGIA | | | | | | | |
| L. B. B. | 28026 | ♂ juv. | Roswell | Oct. 2, 1914 | Hembree | 96–7 | 67 | .. | .. | olive |
| | 28027 | ♀ juv. | Roswell | Oct. 7, 1915 | Hembree | 93 | 64 | .. | .. | olive |
| | 28857 | ♀ juv. | Roswell | Sept. 20, 1916 | Hembree | 94 | 64 | .. | .. | olive |
| Kennard | .. | ♂ | Roswell | Oct. 10, 1923 | Hembree | 94 | 61 | 29 | 12 | olive |
| Biol. Sur. | 338727 | ♂ | Athens | Sept. 17, 1932 | Burleigh | 94.5 | 66.5 | 28 | 12 | olive |
| Other records: | | | | | | | | | | |
| Savannah, May 16, 1910 Perry (Wayne 1910). | | | | | | | | | | |
| Atlanta, Sept. 25, 1927 Greene (identified by Howell), (Survey records). | | | | | | | | | | |
| Fulton Co. (Roswell?) Sept. 6, 1933, Hembree (identified by Oberholser) (Greene 1934). | | | | | | | | | | |
| Mt. Enota, injured, captured and measured by Greene (Greene 1934). | | | | | | | | | | |
| | | | FLORIDA | | | | | | | |
| U. M. M. Z. | 43531 | ♂ | Eau Gallie, Brevard Co. | May 3, 1910 | Worthington | 91– (fr.) | 63 | 28 | 13 | brown or intermediate |
| F. M. N. H. | 70076 | ♂ im. | Nassau Co. | May 8, 1916 | Worthington | 94 | 67 | 30 | 12 | brown or intermediate |
| Other records: | | | | | | | | | | |
| P. M. N. H. 3297 ♂ Amelia Is., May 14, 1897 Beers. | | | | | | | | | | |
| (The Key West specimen in the Field Museum is a northern gray-cheek). | | | | | | | | | | |

## WINTER DISTRIBUTION

| Collection | No. | Sex | Locality | Date | Collector | Wing mm. | Tail mm. | Tarsus mm. | Bill mm. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | WEST INDIES | | | | | | | |
| F. M. N. H. | 4964 | ♂ | Aguacate, S. D. | Feb. 22, 1895 | Cherrie | 97–8 | 69 | 30 | 12 | gray or perhaps intermediate? |
| | 5030 | ♂ im. | Aguacate, S. D. | Feb. 25, 1895 | Cherrie | 91–2 | 63 | 29 | 11 | brownish? |
| | 26822 | ♀ ad. | Puerto Plata, S. D. | Dec. 14, 1882 | Cory | 92 | 64 | 30 | 11 | distinctly brown |
| | 26823 | ♂ ad. | Puerto Plata, S. D. | Dec. 16, 1882 | Cory | 94–5 | 65 | 29 | 11.5 | distinctly brown |
| Brit. M. | .. | ♀ | Puerto Plata, S. D. | Jan. 8, 1883 | Cory | .. | .. | .. | .. | W.94 (Kinnear), 96.5 (Cory) |
| A. M. N. H. | 448949 | ♂ im. | Sanchez, S. D. | Dec. 27, 1906 | Verrill | 94 | 67 | 30 | 11.5 | olive (in Rothschild collection) |
| Other records: | | | | | | | | | | |
| Morne Malanga, Haiti, Jan. 19, 1928 (Bond 1928, Lonnberg 1929). | | | | | | | | | | |
| Cay Sal, Bahamas, May 14–19, 1891 Winch (Cory 1891). | | | | | | | | | | |
| South America: no authentic records. | | | | | | | | | | |

## ACCIDENTAL RECORDS

| *Collection* | *No.* | *Sex* | *Locality* | *Date* | *Collector* | *Wing mm.* | *Tail mm.* | *Tarsus mm.* | *Bill mm.* | *Remarks* |
|---|---|---|---|---|---|---|---|---|---|---|
| L. B. B. | 15670 | ♀ | Maple Creek, Sask. | June 8, 1906 | Bishop | 91–2 | 63 | 29 | .. | nearly as gray as breeding gray-cheek |
| Flem. | 7058 | ♂ | Hamilton, Ont. | May 24, 1892 | McIlwraith | 97 | 63 | 30.5 | 14 | brown |
| | 7059 | ♂ | Hamilton, Ont. | June 2, 1892 | McIlwraith | 97 | 65 | 30 | 13 | brown |
| R. O. M. Z. | 27.9.1.366 | ♀ | Long Point, Ont. | June 4, 1927 | Baillie | 92 | 62 | .. | .. | olive phase |
| | 29.9.30.49 | ♀ | Long Point, Ont. | Sept. 25-6, '29 | Saunders | 95 | 67 | .. | .. | olive phase, like Mansfield migrants |
| | 30.10.28.10 | ♂ im. | Long Point, Ont. | Sept. 26, .. | Saunders | 94–5 | 64 | .. | .. | olive phase, like Mansfield migrants |
| Other records for Ontario: | | | | | | | | | | |
| Exeter, Sept. 15, 1900 E. T. Seton—"with *bicknelli* in both color and size" Ridgway. | | | | | | | | | | |
| Toronto, Sept. 16, 1889 E. T. Seton—"with *bicknelli* in both color and size" Ridgway. | | | | | | | | | | |
| Bryanston, Sept. 16, 1898 Elliot, (identified by R. H. Howe Jr., Saunders 1905). | | | | | | | | | | |
| Nat. Mus. | 162011 | ♀ | Vincennes, Ind. | May 7, 1890 | Hasbrouck | 93–4 | 65.5 | 29 | 13 | olive |
| M. C. Z. | 11280 | ♀ | Cook Co., Ill. | May 6, 1883 | Coale | 92 | 62 | 27 | 11.5 | olive |
| .. | .. | .. | Warsaw, Ill. | May 24, 1884 | Worthen | .. | .. | .. | .. | identified by Ridgway |
| M. C. Z. | .. | .. | Warsaw, Ill. | May 25, 1902 | Worthen | 93–5 | 62.5 | 28 | 13.5 | decidedly olive |
| Brodkorb | .. | ♂ im. | Highland Park, Ill. | Sept. 9, 1906 | Coale | 95 | 60 | 28 | .. | intermediate |
| Ala. M. N. H. | 700 | ♀ | Greensboro, Ala. | Oct. 1, 1890 | Avery | 94 | 62 | 28 | 11 | olive |
| | 703 | ♀ | Greensboro, Ala. | Sept. 20, 1893 | Avery | 93 | 59 | 30 | 12 | olive |
| Nat. Mus. | 263400 | .. | New Orleans, La. | May 1, 1897 | Allison | 95 | 62 | 28 | 12 | olive phase |
| Other records: | | | | | | | | | | |
| Breton Is., May 16, 1917, Arthur (Arthur 1918). | | | | | | | | | | |
| Brit. M. | .. | .. | Cozumel Is., Yucatan | Apr. 30, 1885 | .. | 96 | .. | .. | .. | might not be *bicknelli* |
| | .. | .. | Ruatan Is., Bay of Hond. | 8?, 1886 | .. | 95 | .. | .. | .. | might not be *bicknelli* |